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A NEW DIRECTION FOR FEDERAL OIL SPILL RESEARCH AND DEVELOPMENT

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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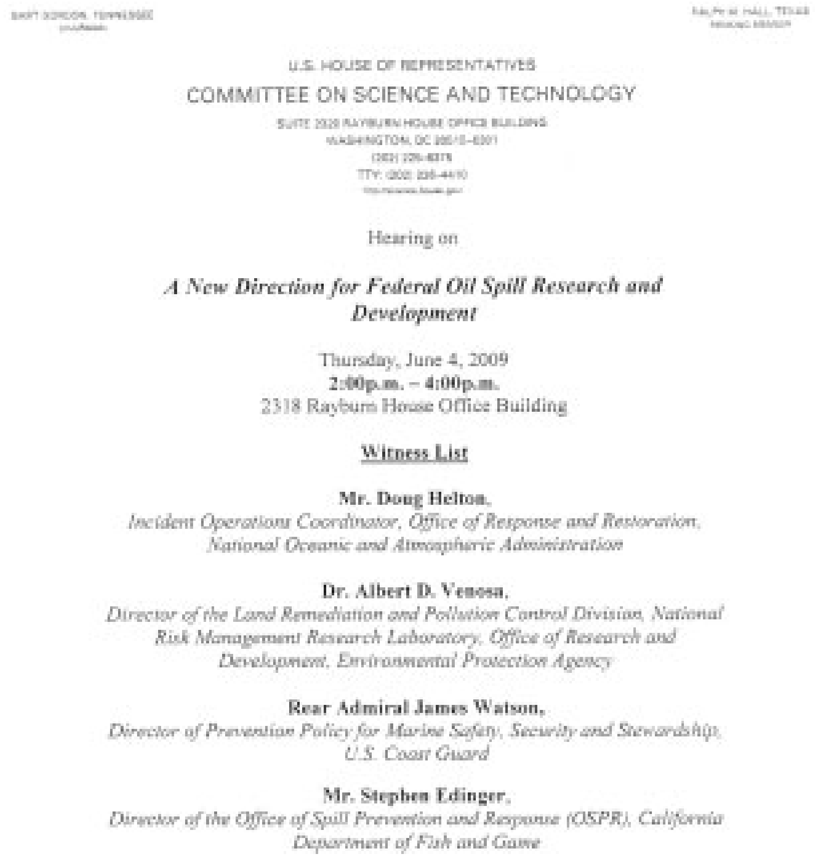
A NEW DIRECTION FOR FEDERAL OIL SPILL RESEARCH AND DEVELOPMENT

THURSDAY, JUNE 4, 2009

House of Representatives,
Subcommittee on Energy and Environment,
Committee on Science and Technology,
Washington, DC.

The Subcommittee met, pursuant to call, at 2:04 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Brian Baird [Chairman of the Subcommittee] presiding.



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Hearing on

A New Direction for Federal Oil Spill Research and Development

Thursday, June 4, 2009
2:00p.m. – 4:00p.m.
2318 Rayburn House Office Building

Witness List

Mr. Doug Helton,
Incident Operations Coordinator, Office of Response and Restoration, National Oceanic and Atmospheric Administration

Dr. Albert D. Venosa,
Director of the Land Remediation and Pollution Control Division, National Risk Management Research Laboratory, Office of Research and Development, Environmental Protection Agency

Rear Admiral James Watson,
Director of Prevention Policy for Marine Safety, Security and Stewardship, U.S. Coast Guard

Mr. Stephen Edinger,
Director of the Office of Spill Prevention and Response (OSPR), California Department of Fish and Game

HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

A New Direction for Federal Oil Spill Research and Development

THURSDAY, JUNE 4, 2009
2:00 P.M.–4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Thursday, June 4th, the Subcommittee on Energy and Environment will hold a hearing entitled *"A New Direction for Federal Oil Spill Research and Development"* at 2 p.m. in Room 2318 of the Rayburn House Office Building. The purpose of the hearing is to examine current federal research and development efforts to prevent, detect, or mitigate oil discharges and to receive testimony on the *Federal Oil Spill Research Program Act of 2009.*

Witnesses

- **Mr. Doug Helton, Incident Operations Coordinator, National Oceanic Atmospheric Administration's (NOAA) Office of Response and Restoration (OR&R).** Mr. Helton assists in managing NOAA's scientific support team during oil and chemical spill responses. In addition, he works to ensure that NOAA's oil spill response services are provided quickly and are useful to the U.S. Coast Guard, Environmental Protection Agency, and other on-scene responders.
- **Dr. Albert D. Venosa, Director of the Land Remediation and Pollution Control Division at the National Risk Management Research Laboratory, Environmental Protection Agency's Office of Research and Development (ORD).** Dr. Venosa directs EPA's research related to oil spill remediation and mitigation. Dr. Venosa's twenty-year tenure in this area of work includes assessing the effectiveness of nutrient formulations in the field for stimulating enhanced bio-degradation of contaminated shorelines in Prince William Sound as part of the Alaska Oil Spill Bioremediation Project.
- **Rear Admiral James Watson, Director of Prevention Policy for Marine Safety, Security and Stewardship, United States Coast Guard (USCG).** Rear Admiral Watson serves as Director of Prevention Policy Development for most legislative mandates regarding oil pollution prevention. His work includes oversight of Vessel Response Plans, oily-water separators, ballast systems, navigation safety systems, and pollution investigations.
- **Mr. Stephen Edinger, Director of the Office of Spill Prevention and Response (OSPR), California Department of Fish and Game.** Mr. Edinger is the senior State of California Official responsible for oil spill prevention and response. Steve is an experienced law enforcement officer and Incident Commander and served as the State-On-Scene Coordinator for the *M/V COSCO BUSAN* oil spill response.

Background

Approximately three million gallons of oil, or refined petroleum product, are spilled into U.S. waters every year.[1] When one of the hundreds of annual spills occur, the Federal Government takes primary action through the Coast Guard or Environmental Protection Agency depending on the location of the accident. As a part of the federal response, the National Oceanic and Atmospheric Administration often plays a vital role in providing real time data and forecasting to assist in the recovery and mitigation efforts. In 2008, NOAA received requests for scientific assistance related to 169 environmental incidents, three-quarters of which were oil spills.[2]

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[1] National Research Council (2005) "Oil Spill Dispersants: Efficacy and Effects." pg. 1.

In March of 1989, the *Exxon Valdez* oil tanker ran aground on Bligh Reef in Alaska's Prince William Sound, rupturing its hull and spilling nearly 11 million gallons of crude oil. The oil slick spread over 11,000 square miles of ocean and onto over 350 miles of beaches in Prince William Sound. It was the largest single oil spill in U.S. coastal waters.[3] The direct result of *Exxon Valdez* was the passing of the *Oil Pollution Act of 1990* (OPA), which clarified jurisdictional ambiguities in previous legislation. The Act addressed many factors in preventing, detecting, or mitigating oil spills.

Title VII of OPA created an interagency oil spill research and technology program nineteen years ago. According to the Committee on the Marine Transportation of Heavy Oils, which was established by the National Research Council (NRC) at the request of the U.S. Coast Guard, for most spills only about 10 to 15 percent of the oil is recovered, and the best recovery rates are probably about 30 percent.[4] Given these low recovery percentages, additional research and development is necessary to reach acceptable levels of mitigation.

The Oil Pollution Act of 1990, P.L. 101–380 (8–18–1990)

Title VII—Oil Pollution Research and Development Program

The *Oil Pollution Act*'s Title VII created a program to conduct research and development on oil spill prevention and response. The Title established an Interagency Coordinating Committee to coordinate a comprehensive research and development effort among 14 federal agencies and to coordinate federal research and development activities with those of State and local governments, industries, universities, other foreign governments. The law designated the Coast Guard as the Committee Chairman and defined membership to include:

1. The National Oceanic and Atmospheric Administration (DOC)
2. National Institute of Standards and Technology (DOC)
3. The Department of Energy
4. The Minerals Management Service (DOI)
5. The United States Fish and Wildlife Service (DOI)
6. The United States Coast Guard (Originally DOT, now DHS)
7. The Maritime Administration (Originally DOT, now DHS)
8. The Pipeline and Hazardous Materials Safety Administration[5] (DOT)
9. The Army Corps of Engineers (DOD)
10. The Navy (DOD)
11. The Environmental Protection Administration
12. The National Aeronautics and Space Administration
13. The United States Fire Administration (now DHS)
14. The Federal Emergency management Agency (now DHS)

The research program was authorized at $28 million per year for five years with $6 million per year of the total designated for the Regional Research Program.

The Committee was tasked with developing a research plan to investigate technologies to prevent and clean up spills, ways to restore damaged natural resources, and the long-term environmental effects of spills. In addition, the Committee was tasked with the management of a Regional Research Program. The Regional program administers competitive grants to universities or other research institutions to address regional oil pollution needs. OPA authorized a total of $600,000 per year over five years to each of the ten Coast Guard regions. Finally, the Title directed the Coast Guard to conduct oil pollution minimization demonstration projects, only some of which were carried out due to a lack of funding.

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[2] NOOA (2009) FY 2010 Budget Summary. May 11, 2009. pg. 2–31.

[3] NOAA (2009) *Exxon Valdez Oil Spill Website.* National Ocean Service. Office of Response and Restoration Website. *http://response.restoration.noaa.gov/.* Accessed on May 20, 2009.

[4] National Research Council (1999) *Spills of Non-Floating Oils.* Committee on Marine Transportation of Heavy Oils. National Research Council. National Academy Press. Washington, D.C. Pg. v.

[5] Originally called the Research and Special Projects Administration this program was renamed the Pipeline and Hazardous Materials Safety Administration in the *Norman Y. Mineta Research and Special Programs Improvement Act* (P.L. 108–426).

Since the OPA passed there has been little legislative activity to amend the Oil Pollution Research and Development Plan. Two laws, the *Great Lakes Fish and Wildlife Restoration Act of 1990* and the *Aquatic Nuisance Prevention and Control Act of 1990* created a port oil pollution demonstration project in the Great Lakes. Finally, in 1996, the *Coast Guard Authorization Act* authorized the Prince William Sound Oil Spill Recovery Institute and the Center for Marine Training and Safety in Galveston, Texas to conduct oil spill research and development.

OPA Research and Development Program

The Interagency Coordinating Committee on Oil Pollution Research produced the first Oil Pollution Research and Technology Plan in 1992, and after consulting with the National Academy of Sciences, submitted a second plan in 1997. The plans identified and prioritized twenty research and development program areas. These areas focused on spill prevention; spill response planning, training, and management; spill countermeasures and cleanup; fate and transport; and effects, monitoring and restoration and assigned R&D focus areas to ten member agencies. There has been no update of the research plan since 1997.

Despite the Interagency Committee's detailed research plan, there have been modest technological advances in oil spill cleanup technology since the enactment of the law in 1990. The Interagency Coordinating Committee on Oil Pollution Research reported that, as late as 1997, "most of the technology and information gaps of 1990 remain," due to a failure to appropriate sufficient funds for oil pollution technology programs.[6]

Four agencies—the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Administration (EPA), the Mineral Management Services (MMS), and the Coast Guard—have conducted the majority of oil pollution research. Funding levels have been far lower than the $28 million per year originally authorized for the program.

U.S. Coast Guard

The U.S. Coast Guard is the lead federal response agency for coastal waters and deepwater ports, and conducts research through its Research and Development Center in Groton, Connecticut. Specifically, the Coast Guard has focused on four main areas: spill response planning and management, spill detection and surveillance, vessel salvage and on-board containment, and spilled oil cleanup and countermeasures. Over the past decade, the Coast Guard has spent approximately $20 million on oil spill research and development.

The Environmental Protection Agency (EPA)

EPA seeks to prevent, prepare for, and respond to oil spills that occur in the inland waters of the United States, and EPA is the lead federal response agency for such spills. The Office of Emergency Management (OEM) provides the responder personnel, while the research work, which addresses mitigation, fate and effects, and spill flow characteristics, is conducted through the Office of Research and Development's (ORD) National Risk Management Research Laboratory.

In FY 2009, the Oil Spill Response Program received $720,000, a modest but historically stable budget, to conduct research and development at EPA.[7] The Program's objective is to provide environmental managers with the "tools, models, and methods needed to mitigate the effects of oil and biofuel spills on ecosystems." EPA's program includes focused work into spill mitigation through bioremediation, chemical and physical countermeasures, and ecotoxity effects.[8]

The National Oceanic and Atmospheric Administration (NOAA)

NOAA's Office of Response and Restoration (OR&R) provides immediate operational and scientific support during the assessment, response, and cleanup phases. In the role as science advisors to the Federal On-Scene Coordinator, OR&R provided spill trajectory, resources at risk, and early spill impact information during the initial stages of the spill. Once the focus shifted from response to cleanup, OR&R addressed issues related to the effectiveness and environmental effects of cleanup technologies.[9]

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[6] Interagency Coordinating Committee on Oil Pollution Research (1997) *Oil Pollution Research and Technology Plan.*

[7] EPA (2009) *FY 2010 Congressional Budget Justification.* EPA–2–5–E–09–001. Pg. 160.

[8] EPA (2009) *Congressional Briefing on OPA 1990 to the Science and Technology Committee.* May 12, 2009.

Although there is currently no funded oil spill response research and development program in NOAA, the *Oil Pollution Act* does grant NOAA the authority to carry out research and development. From 2004–2007, NOAA received funding for the Coastal Response Research Center in New Hampshire, which brings together the resources of the University of New Hampshire and the field expertise of OR&R to conduct and oversee basic and applied research, perform outreach, and encourage strategic partnerships in spill response, assessment and restoration. Aside from this funding, NOAA has received no direct appropriation for NOAA research and development for spill response.

The Minerals Management Service (MMS)

MMS's Oil Spill Response Research Program (OSRR) focuses on improving the knowledge and technologies used for detection, containment and cleanup of oil spills that may occur on the outer continental shelf. MMS also operates OHMSETT—the National Oil Spill Response Test Tank Facility—in Leonardo, New Jersey. Funding for MMS's programs is appropriated from the Oil Spill Liability Trust Fund (OSLTF). While OSLFT had received funds from an oil tax from oil imported into the U.S., once the fund reached one billion dollars, the tax was suspended. Currently, funds are generated from interest on the fund, cost recovery from responsible parties, and penalties.

Draft Legislation

In November 2007, a 900-foot container ship, the *Cosco Busan,* struck the San Francisco Bay Bridge, spilling over 50,000 gallons of oil into the Bay. This accident brought renewed attention and focus to current Federal Government procedures, practices, and research. Spills such as the *Cosco Busan* can be costly. The cleanup costs for this relatively small spill were close to $100 million. Following this event and other recent accidents, it is clear that the United States needs a more robust research and development strategy to reduce the environmental and economic impacts of oil spills. Currently, responders face a number of emerging threats arising from an increase in maritime transportation, potential for offshore energy exploration in remote locations, aging infrastructure, and new fuel stocks and blends.

More than ten federal and numerous State and local agencies are called upon to assist in the federal response team in some manner. Given the high environmental and economic cost of oil spills such as the *Cosco Busan* and the current lack of directed research, a reinvigorated and streamlined research and development program would help to improve the effectiveness of oil spill response efforts and ecosystem mitigation at a fraction of the cost of a single large spill.

For these reasons, Representative Lynn Woolsey (D–CA) plans to introduce legislation to reorient the current federal interagency research and development program created in OPA. The draft legislation seeks to improve the Federal Government's research and development efforts to prevent, detect, or mitigate oil discharges. The bill provides a new direction to the existing program by guiding research towards emerging threats and streamlining a cumbersome interagency structure. Through this reauthorization, the responsible federal agencies will be better equipped to quickly and effectively respond to oil discharges both inland and in coastal waters.

Federal Oil Spill Research Program Act

SECTION-BY-SECTION

Title: Federal Oil Spill Research Program Act

Purpose: To amend Title VII of the *Oil Pollution Act of 1990* and for other purposes.

Section 1: Short Title

Federal Oil Spill Research Program Act

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[9] NOAA (2009) *Exxon Valdez Oil Spill Website.* National Ocean Service. Office of Response and Restoration Website. Accessed on May 20, 2009.

Section 2: Federal Oil Spill Research Committee

Section 2 directs the President to establish an interagency committee to be known as the Federal Oil Spill Research Committee ('Committee'). The President shall designate a representative of the National Oceanic and Atmospheric Administration to serve as Chairperson of the Committee, and the members of the Committee shall include representatives from NOAA, the United States Coast Guard, the Environmental Protection Agency, and such other federal agencies as the President may designate.

Section 2 requires the Committee to: 1) coordinate a federal oil spill research program ('Program') to coordinate oil pollution research, technology development, and demonstration among the federal agencies, in cooperation and coordination with industry, institutions of higher education, research institutions, State and tribal governments, and other relevant stakeholders; 2) complete a research assessment ('Assessment') on the status of oil spill prevention and response capabilities; and 3) develop a federal oil spill research plan ('Plan'). The Assessment will provide the Committee with the information necessary to create the Plan.

Section 3: Federal Oil Spill Research Program

Section 3 requires the Committee to establish a Program for conducting oil pollution research, development, and demonstration. The Program shall focus on new technologies, practices, and procedures that provide for effective and direct response to prevent, detect, recover, or mitigate oil discharges.

Section 4: Federal Research Assessment

Section 4 instructs the Committee to submit to Congress an Assessment of the status of oil spill prevention and response capabilities that identifies current oil pollution research and development programs, identifies regional oil pollution research needs and priorities, assesses the status of knowledge of oil pollution prevention, response, and mitigation technologies, and assesses the status of real-time data available to mariners, researchers, and responders. The Assessment shall be subject to a 90-day public comment period and shall incorporate public input as appropriate. The Committee is required submit the Assessment to Congress no later than one year after the enactment of Section 4.

Section 5: Federal Research Interagency Plan

Section 5 directs the Committee to develop a Plan to establish federal oil spill research and development priorities. In developing the Plan, the Committee shall consider and utilize recommendations from the National Academy of Sciences, as well as State, local, and tribal governments. The Plan will make recommendations for improving oil spill recovery, mitigation, technologies, practices, procedures, and the quality of real-time data available to mariners, researchers, and responders. The Assessment shall be subject to a 90-day public comment period and shall incorporate public input as appropriate. The Committee is required to submit the Plan to Congress no later than one year after the submission of the Assessment.

Section 6: Extramural Grants

Section 6 instructs the Secretary of Commerce, acting through the Administrator of NOAA, to award competitive grants to institutions of higher education and other research institutions to advance research, development, and demonstration of technologies for preventing, detecting, or mitigating oil discharges in accordance with the goals and priorities of the Plan. The Secretary shall incorporate a competitive, merit-based process for awarding grants under Section 6.

Section 7: Annual Report

Section 7 requires the Committee to submit an annual report to Congress, concurrent with the annual submission of the President's budget, describing the activities and results of the Program during the previous fiscal year and outlining objectives for the next fiscal year.

Section 8: National Academy of Science Participation

Section 8 instructs the Secretary of Commerce, acting through the Administrator of NOAA, to contract with the National Academy of Sciences to assess and evaluate the status of federal oil spill research and development prior to the enactment of the *Federal Oil Spill Research Program Act* and to submit: 1) an assessment of the program prior to enactment of the legislation; 2) a report to the Committee evaluating the conclusions and recommendations from the Assessment to be utilized in the creation of the Plan; and 3) a report to Congress evaluating the Committee's Plan, no later than one year after the Committee submits the Plan.

Section 9: Technical and Conforming Changes

Section 9 makes technical and conforming changes to the *Oil Pollution Act of 1990.*

Chairman BAIRD. We will bring our hearing to order. I want to thank all our participants for being here. The hearing will now come to order. I want to welcome everyone to today's hearing on investigating federal oil spill research and development. Our hearing today provides us with an opportunity to examine current federal R&D efforts to prevent, detect, or mitigate oil discharges.

In addition, the Subcommittee will receive testimony on new legislation introduced by Representative Woolsey entitled, *"The Federal Oil Spill Research Program Act of 2009."* As a co-sponsor of the legislation I want to thank Ms. Woolsey for her dedication to this important issue.

The *Exxon Valdez* disaster of 1989 provided the impetus for the passage of the *Oil Pollution Act of 1990,* also known as OPA 90, which expanded the oil prevention, preparedness, and response capacity of the Federal Government and industry. OPA 90 has been a success story in many ways. However, new challenges exist today that were not apparent when the bill was authorized.

Although oil leaked from tankers has vastly decreased, oil spills from other vessels and from on-land sources remain high. In 2007, a 900-foot container ship, the *Cosco Busan,* struck the San Francisco Bay Bridge, spilling over 50,000 gallons of oil into the Bay. That accident has brought renewed attention and focus to current Federal Government procedures, practices, and research. Following that event and other recent accidents it is clear that the United States needs a more robust research and development strategy to reduce the environmental and economic impacts of oil spills.

Currently, responders face increasing challenges arising from an increase in maritime transportation, potential for onshore energy exploration in remote locations, aging infrastructure, and new fuel stocks and blends. Title VII of OPA 90 created an interagency oil spill research and development program with the goal of coordinating federal research to encourage the development of new technologies to address oil spills.

Despite the interagency committee's detailed research plan, there have been modest technological advances in oil spill cleanup technologies since the enactment of the law in 1990. According to the Committee on Maritime Transportation of Heavy Oils, most oil spills experience a 10 to 15 percent rate of recovery. More recent estimates have reported an increase in recovery rates to 40 percent in best-case scenarios.

Given these low recovery percentages, additional research and development is necessary to reach acceptable levels of mitigation. The *Federal Oil Spill Research Program Act* authored by Ms. Woolsey seeks to re-orient the current federal interagency research and development program created in OPA. The legislation would improve the Federal Government's research and development efforts to prevent, detect, or mitigate oil discharges. The bill provides a new direction to the existing program by guiding research towards new challenges and making interagency structures for this program more efficient.

Through this reauthorization, the responsible federal agencies will be better equipped to quickly and effectively respond to oil discharges, both inland and in coastal waters.

We have an excellent panel of witnesses with us this morning who will share their views on oil spill responses, recovery, and mitigation, and I thank you all for being with us here today. I look forward to your suggestions relating the *Federal Oil Spill Research Act.*

And we have been joined at this point by the author of the proposed legislation, Ms. Woolsey. Ms. Woolsey, I have been singing your praises in your absence and will do so again throughout today's hearing.

[The prepared statement of Chairman Baird follows:]

PREPARED STATEMENT OF CHAIRMAN BRIAN BAIRD

Good morning and welcome to today's hearing investigating federal oil spill research and development.

This morning's hearing provides us with an opportunity to examine current federal R&D efforts to prevent, detect, or mitigate oil discharges. In addition, the Subcommittee will receive testimony on new legislation introduced by Representative Woolsey entitled, the *Federal Oil Spill Research Program Act of 2009.* As a co-sponsor of this legislation, I want to thank Ms. Woolsey for her dedication to this important issue.

Twenty years ago, the *Exxon Valdez* oil tanker ran aground and spilled nearly 11 million gallons of crude oil in Alaska's Prince William Sound. In its first sweep, the oil spill killed about 250,000 seabirds, 4,000 sea otters, 250 bald eagles, and more than 20 orca whales, according to World Wildlife Federation. Two decades later, huge quantities of oil still coat Alaska's shores. Of the 11 million gallons of crude oil that drained from the stranded tanker, more than 20,000 gallons remain in isolated coves and underneath the sand.

The *Exxon Valdez* disaster provided the impetus for the passage of the *Oil Pollution Act of 1990* (OPA 90), which expanded the oil prevention, preparedness, and response capabilities of the Federal Government and industry.

The OPA 90 has been a success story in many ways. Since the bill was signed into law, the volume of oil spilled from tankers into U.S. waters has fallen from an average of 70,000 barrels per year to an average of 4,000 barrels per year—a decrease of 95 percent. A phased move from single to double hulls is one of the most visible of OPA 90's achievements.

However, new challenges exist today that were not apparent when the bill was authorized. Although oil leaked from tankers has vastly decreased, oil spills from other vessels and from on-land sources remain high. In 2007, a 900-foot container ship, the *Cosco Busan,* struck the San Francisco Bay Bridge, spilling over 50,000 gallons of oil into the Bay. This accident has brought renewed attention and focus to current Federal Government procedures, practices, and research.

Following this event and other recent accidents, it is clear that the United States needs a more robust research and development strategy to reduce the environmental and economic impacts of oil spills. Currently, responders face increasing challenges arising from an increase in maritime transportation, potential for offshore energy exploration in remote locations, aging infrastructure, and new fuel stocks and blends.

Title VII of OPA 1990 created an "Interagency Oil Spill Research and Development Program" with the goal of coordinating federal research to encourage the development of new technologies to address oil spills. Despite the Interagency Committee's detailed research plan, there have been modest technological advances in oil spill cleanup technology since the enactment of the law in 1990. In the last Plan issued by the Interagency Coordinating Committee on Oil Pollution Research, released in 1997, the Committee reported "most of the technology and information gaps of 1990 remain."

According to the Committee on the Marine Transportation of Heavy Oils, most oil spills experience a 10 to 15 percent rate of recovery. More recent estimates have reported an increase in recovery rates to 40 percent in best case scenarios. Given these low recovery percentages, additional research and development is necessary to reach acceptable levels of mitigation.

Due to the high environmental and economic cost of oil spills such as the *Cosco Busan* and the current lack of directed research, a reinvigorated research and development program is needed to improve the effectiveness of oil spill response efforts and ecosystem mitigation at a fraction of the cost of a single large spill.

The *Federal Oil Spill Research Program Act* seeks to reorient the current federal interagency research and development program created in OPA. The legislation would improve the Federal Government's research and development efforts to prevent, detect, or mitigate oil discharges. The bill provides a new direction to the existing program by guiding research towards new challenges and making the interagency structure for this program more efficient. Through this reauthorization, the responsible federal agencies will be better equipped to quickly and effectively respond to oil discharges both inland and in coastal waters.

We have an excellent panel of witnesses with us this morning who will share their views on oil spill response, recovery, and mitigation. I thank you all for being with us here today, and I look forward to your suggestions related to the *Federal Oil Spill Research Program Act.*

Chairman BAIRD. At this point I would like to yield time to Representative Woolsey and then in one moment I will recognize Mr. Inglis.

Ms. Woolsey.

Ms. WOOLSEY. Well, thank you very much, Mr. Chairman and Mr. Ranking Member and panel for being here to talk about something that is very important to me and holding this hearing and also for allowing me to make an opening statement.

Oil spill prevention and mitigation is important to me, not only because I think it is vital to protect the environment and our coastal economies but also because my district has been seriously affected by what many consider a minor spill. Well, ha, ha. As a result of this I have been witness to how difficult an oil spill cleanup effort can be, even with the best available technology.

As some of you remember, on November 7, 2007, the container ship *Cosco Busan* collided with the San Francisco Bay Bridge and released 58,000 gallons of oil into San Francisco Bay. Because of the complex tidal mechanics that are present in the Bay, the spill spread rapidly and quickly affected a large area of the north coast, including the Golden Gate National Recreation Area, the Point Reyes National Seashore, and both the Gulf of the Farallones and Monterey Bay National Marine Sanctuaries. The pristine beaches of Marin County were soiled, waters off our federal parklands were sullied, and important restoration projects in Richardson and San Pueblo Bay were threatened.

In addition, the spill killed thousands of birds, many marine mammals, and no one knows how many fish, and I can't help but think that this oil spill played at least some part in the closure of the Sacramento River Salmon Fishery that migrates through the San Francisco Bay on their way out to sea.

All in all, about 200 miles of coastline were affected by this one minor spill. That is why I have introduced H.R. 2693, the *Federal Oil Spill Research Program Act.* This bill coordinates federal research and development of oil spill prevention, detection, recovery, and mitigation to ensure that all the relevant agencies are working together for common solutions.

In addition, the bill provides grants to institutes of higher learning and research centers to improve technologies that can be used to prevent, combat, and clean up oil spills. One thing that I heard again and again from the people who were tasked with cleaning up our mess was that the technology they were using just wasn't adequate to get the job done. Actually, of the 58,000 gallons of oil that were spilled into San Francisco Bay, only a little more than 40 percent of that amount was recovered.

It is clear that current technology is inadequate to prevent and protect us from oil spills if we can only recover such a small percentage with what is available to us today. I know that the right focus and with the right focus and effort we can do much, much better. I am hoping that H.R. 2693 will help to ensure that we will take an active role to prevent oil spills and when they do occur, we have the best possible technology to minimize negative impacts.

So, again, Mr. Chairman, thank you for letting me spout off. I am really proud that you are—we are introducing this legislation, and we will hear from these great witnesses. Thank you very much.

[The prepared statement of Ms. Woolsey follows:]

PREPARED STATEMENT OF REPRESENTATIVE LYNN C. WOOLSEY

Mr. Chairman, thank you for holding this hearing today, and for allowing me to make an opening statement.

Oil spill prevention and mitigation is important to me not only because I think it's vital to protect the environment and coastal economies, but also because my District has been seriously affected by what many consider a minor spill. And as a result of this, I've been witness to how difficult an oil spill cleanup effort can be . . . even with the best available technology.

As some of you remember, on November 7, 2007, the container ship *Cosco Busan* collided with the San Francisco Bay Bridge, and released 58,000 gallons of oil into San Francisco Bay.

Because of the complex tidal mechanics that are present in the Bay, the spill spread rapidly and quickly affected a large area of the north coast, including the Golden Gate National Recreation Area; the Point Reyes National Seashore; and both the Gulf of the Farallones and Monterey Bay National Marine Sanctuaries.

The pristine beaches of Marin County were soiled, waters off of our federal parklands were sullied, and important restoration projects in Richardson and San Pablo Bay were threatened.

In addition, the spill killed thousands of birds, many marine mammals, and no one knows how many fish . . . and I can't help but think that this oil spill played at least some part in the closure of the Sacramento River salmon fishery that migrates through the San Francisco Bay on their way out to sea. All in all, about 200 miles of coastline were affected by this spill.

That's why I have introduced the H.R. 2693, the *"Federal Oil Spill Research Program Act."* This bill coordinates federal research and development of oil spill prevention, detection, recovery, and mitigation to ensure that all the relevant agencies are working together for common solutions.

In addition, the bill provides grants to institutes of higher learning and research centers to improve technologies used to prevent, combat, and clean up oil spills.

One thing that I heard again and again from the people who were tasked with cleaning up our mess was that the technology they were using just wasn't adequate to get the job done. Actually, of the 58,000 gallons of oil that were spilled into San Francisco Bay, only about a third of that amount was recovered.

It's clear that current technology is inadequate to prevent and protect us from oils spills if we can only recover such a small percentage with what's available. And, I know with the right focus and effort, we can do much, much better.

H.R. 2693 will help to ensure that the Federal Government is taking an active role to prevent oil spills, and that when they do occur, we have the best possible technology to minimize negative impacts to ourselves and the environment.

Mr. Chairman, again, I thank you for holding this hearing, and I look forward to the testimony from our distinguished witnesses.

Chairman BAIRD. I am happy to do so, Ms. Woolsey. Your passion for the issue comes through both in your words today and in many of your actions as a Member of Congress over the many years but also in the context of this legislation.

I am now pleased to recognize our distinguished Ranking Member, Mr. Inglis, for his opening remarks.

Mr. INGLIS. Thank you, Mr. Chairman. Thank you for holding this hearing.

In many ways this hearing is an opportunity to applaud the progress and success of NOAA, U.S. Coast Guard, research labs, and environmental organizations at the State, federal, and local level who have all contributed to a steady decline in oil spill incidents in our nation.

This achievement is especially noteworthy considering that our annual transport of oil and other hazardous materials is not decreasing but growing rather at a rapid pace. So thank you to the witnesses here for your hard work and for the work of those you represent in protecting our waters, wildlife, and ecological systems in the incidence of spills.

But oil spills are one of those areas where we are as a country—where we as a country will stop being worried when we are perfect, and since we are probably never going to be perfect or able to prevent any imaginable accident, we are here to discuss how we can redress our strategies and resources for mitigating the impacts of oil spills.

The 50,000 gallon spill in November of 2007 in the San Francisco Bay area was a reminder that even small spills can be very costly. If they are ways that we can be promoting research and development to improve response and cleanup while driving down the cost of those efforts, we have a responsibility to encourage that research.

I appreciate Congresswoman Woolsey's proactive efforts to bring legislation before this subcommittee, and I look forward to hearing our witnesses' thoughts on this bill. I am especially interested to hear what deficiencies exist in the current interagency coordination efforts and if new legislation is necessary to correct these shortcomings.

Thank you, again, Mr. Chairman. I yield back.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Good afternoon, and thank you for holding this hearing, Mr. Chairman.

In many ways, this hearing is an opportunity to applaud the progress and success of NOAA, the U.S. Coast Guard, research labs, and environmental organizations at the State, federal, and local level, who have all contributed to a steady decline in oil spill incidents in our nation's past. This achievement is especially noteworthy considering that our annual transport of oil and other hazardous materials is not decreasing, but growing at a rapid pace. So thank you to the witnesses here for your hard work, and the work of those you represent, in protecting our waters, wildlife, and ecological systems in the incidents of spills.

But oil spills are one of those areas where we as a country will stop being worried when we're perfect—and since we'll probably never be perfect, or able to prevent any imaginable accident, we're here to discuss how we can readdress our strategies and resources for mitigating the impacts of oil spills. The 50,000 gallon spill in November 2007 in the San Francisco Bay area was a reminder that even small spills can be very costly. If there are ways that we can be promoting research and development to improve response and cleanup, .while driving down the costs of those efforts, we have a responsibility to encourage such changes.

I appreciate Congresswoman Woolsey's proactive efforts to bring draft legislation before this subcommittee, and I look forward to hearing our witnesses' thoughts on this bill. I'm especially interested to hear what deficiencies exist in the current interagency coordination effort, and if new legislation is necessary to correct these shortcomings.

Thank you again, Mr. Chairman, and I yield back.

Chairman BAIRD. I thank the gentleman. If there are other Members who wish to submit additional opening statements, your statements will be added to the record at this point.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good Afternoon. Thank you, Mr. Chairman, for holding today's hearing to examine current federal research and development efforts to address oil discharges and to receive testimony on the *Federal Oil Spill Research Program Act of 2009.*

During the 101st Congress, I voted in support of the *Oil Pollution Act of 1990,* which created an interagency research program on oil spills. This legislation was considered in response to the devastating *Exxon Valdez* oil spill, which covered 11,000 miles of ocean and 350 miles of beaches in a slick of oil. Nearly 20 years later, oil spills continue to occur on our coasts and waterways, resulting in expensive recovery and clean-up efforts.

The U.S. Coast Guard, the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), and the Mineral Management Service (MMS) completed substantial research efforts in the last 20 years to address concerns about oil spills. While these efforts have made advancements in responses to and prevention of massive oil spills, more research is necessary to prevent spills and improve clean-up and recovery programs.

The guidelines set forth in the proposed draft legislation aim to be cost-effective and efficient by streamlining government efforts for research and development. I look forward to hearing from our witnesses to learn more about our current research and to determine what changes may be necessary to the federal oil spill research and development program.

Thank you again, Mr. Chairman.

Chairman BAIRD. I want to thank Mr. Luján for being here as well. Though not a coastal state per se, we very much appreciate your input and participation. Thank you very, very much.

At this point it is my pleasure to introduce our witnesses at this time. Mr. Doug Helton is the Incident Operations Coordinator at the National Oceanic and Atmospheric Administration, Office of Response and Restoration. Dr. Albert D. Venosa is the Director of the Land Remediation and Pollution Control Division of the National Risk Management Research Laboratory, a part of the Office of Research and Development at EPA. Rear Admiral James Watson is the Director of Prevention Policy for Marine Safety, Security, and Stewardship for the U.S. Coast Guard. As I serve on the Coast Guard Subcommittee as well, it is a pleasure to see you in this committee, Admiral Watson. We will try to invite you more frequently on other topics as well.

And at this point I am happy, again, to yield to Ms. Woolsey to introduce our fourth witness, her fellow Californian, Mr. Edinger.

Ms. WOOLSEY. Thank you, Mr. Chairman.

It is my pleasure to introduce Stephen Edinger as a witness before our committee today. Mr. Edinger is the Administrator for the California Department of Fish and Game, Office of Spill Prevention and Response. That probably took up more time than all of yours together, my just saying that. He is a graduate of the University of California–Davis and was appointed as Administrator by Governor Arnold Schwarzenegger in November, 2008. He spent his professional career protecting California's wildlife and natural environments, serving over 28 years in environmental law enforcement.

Mr. Edinger has investigated or served as the Incident Commander on hundreds of pollution events across California, most relevant to this hearing he served as California's incident Commander during the *Cosco Busan* oil spill response in November, 2007.

We look forward to hearing from you, Stephen.

Chairman BAIRD. As our witnesses know, we spoke briefly before the hearing began, you will have five minutes for your spoken testimony. I always have to apologize for that. You spend your entire careers on this, fly a long distance, and we give you five minutes. Your written testimony will be included in the record for the hearing. When you have completed your spoken testimony, we will each begin with questions.

We will start with Mr. Helton.

STATEMENT OF MR. DOUGLAS R. HELTON, INCIDENT OPERATIONS COORDINATOR, OFFICE OF RESPONSE AND RESTORATION, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Mr. HELTON. Thank you, Mr. Chairman and Members of the Committee for the opportunity to talk about NOAA's, National Oceanic and Atmospheric Administration's, role in oil spill pollution response, research and development. My name is Doug Helton. I am the Incident Operations Coordinator for NOAA's Office of Response and Restoration.

During spills I help to manage NOAA's emergency response efforts, including our roles as a scientific advisor to the U.S. Coast Guard or other federal on-scene coordinators responsible for the containment and the response and cleanup of the spill.

Our marine transportation system is an integral part of the U.S. economy, but that transportation bring risks. Tank vessels loaded with large quantities of oil, up to 50 million gallons, transit our waters every day, and tankers and barges are not the only risk. There is also large cruise ships, freighters, container ships, work boats, coastal pipelines, storage facilities, and offshore oil exploration that also pose risks.

Oil spills can cause widespread environmental, economic, and social impacts. The best course of action is to prevent these spills. However, despite our best efforts, there are still thousands of spills every year. Most are small, but the DM–932 barge spill in the Mississippi River last year is a reminder that large spills still occur, and the *Cosco Busan* incident in 2007, is a reminder that even small spills can cause significant impacts.

We need to be prepared to reduce these impacts. NOAA provides products and services critical for making science-based response decisions that prevent further harm, restore natural resources, and promote effective planning for future incidents. Once oil is spilled, our goal is to advise the Coast Guard on the potential fate and impacts of the spill and to coordinate any scientific issues that arise during the response. Last year my office was called 169 times for such support.

In addition to our response role, NOAA is also a natural resource trustee for marine resources under the *Oil Pollution Act,* and we are responsible for ensuring that there is restoration that occurs after these spills.

Strong science is critical to effective decision-making during spill response and restoration, and a robust R&D program can improve how we respond. Congress recognized this need by creating the Interagency Coordinating Committee on Oil Pollution as part of the

Oil Pollution Act. While some funding has been provided over the years, the comprehensive research and development that was envisioned by the *Oil Pollution Act* has not been achieved, and research has actually declined in recent years.

While research has produced advancements and especially in technologies to prevent spills, the response community essentially has the same tools we had 20 years ago during the *Exxon Valdez* spill.

The *Oil Pollution Act* gives NOAA authority to do research and development, and NOAA's most recent efforts in this regards were through a partnership with the University of New Hampshire's Coastal Response Research Center. That research focused on tradeoffs of response technologies including dispersants in burning, deep water well blowouts, arctic and cold water spills, submerged oil, restoration science, modeling and information management and the social dimensions of spills. In a few short years the CRRC has become a focal point for coordination and planning for oil spill research and development.

And while these efforts have been beneficial, there is much additional research that is needed. We need to improve the capabilities for response and restoration in cold water and arctic spills. Increasing vessel traffic and exploration will increase the potential for oil spills in the Arctic, and many of the standard approaches we have now do not work in arctic waters.

There is also a need to develop restoration and assessment technologies for these sensitive resources.

We need improved oil spill modeling. We currently lack the modeling capability to determine how oil will behave when it sinks—how it behaves in ice environments or when it sinks below the surface. Understanding the behavior of oil in the water column is important for a number of reasons, including protecting water intakes and evaluating the effects on fisheries.

For example, in 2004, the *Athos I* oil spill in Delaware River had a neutrally-buoyant oil. That oil was entrained in the Salem Nuclear Power Plants water intakes and resulted in the precautionary closure of that power plant. Better understanding of how that submerged oil would behave would have been important in helping to reduce that closure which was millions of dollars a day in losses.

We need to better use remote sensing technologies, including unmanned aerial vehicles, real-time ocean observation systems. NOAA's trajectory modeling can help direct oil spill responders where the oil is heaviest but using remote sensing would help us direct that cleanup technology more effectively.

We also need a better understanding of the effects of residual oil. We know that from experience residual oil can persist for a long time in the environment. We need to know the tradeoffs associated with leaving that oil in place.

And finally, we need to address the human and social dimensions of spill response. The success of a response is partially dependent upon the—how well the local community is engaged.

So thank you for the opportunity to discuss these issues, and I will stand by to answer any questions you may have.

[The prepared statement of Mr. Helton follows:]

PREPARED STATEMENT OF DOUGLAS R. HELTON

Thank you, Mr. Chairman and Members of the Committee, for the opportunity to testify about the National Oceanic and Atmospheric Administration's (NOAA's) role in oil spill research and development. I am Doug Helton, Incident Operations Coordinator for the Emergency Response Division in NOAA's Office of Response and Restoration.

OVERVIEW

Our marine transportation system is an integral part of the U.S. economy. According to a recent report from the Bureau of Transportation Statistics, our marine transportation system conveys as much as 78 percent of U.S. international merchandise trade by weight and 44 percent by value through our nation's ports each year, far more than any other mode of transportation . Every day vessels containing large quantities of oil—some up to 50 million gallons—travel through our waterways to their destinations. These vessels include not only oil tankers but also container ships, fishing vessels, ferries, and other public and private vessels that carry millions of gallons of fuel oil and some of which may carry hazardous materials as cargo.

Over the past fifty years, ships have doubled in length, width, and draft, and seagoing commerce has tripled. The Department of Transportation projects that by 2020 the volume of maritime trade will more than double from 1998 levels, particularly in international container traffic.[1] Wherever these vessels travel on our waters, there is an associated risk that oil may spill and/or there may be a release of hazardous cargo (if present) into the water or the atmosphere. While vessels take every precaution to avoid these situations, they do happen and when spills occur, they can cause widespread environmental, economic, and social impacts. For example, if an oil spill were to disrupt the movement of commerce at the Port of Los Angeles, it could have economic impacts across the entire country due to the volume of commercial items that come through that port every day. Effective spill response keeps commerce moving and reduces clean-up costs and environmental impacts.

Although our nation's energy policy likely will incorporate more alternative energy sources in the future, the U.S. will continue to rely on oil for years to come. Oil spills are an unfortunate but unavoidable consequence of using oil to fuel our transportation system and meet our domestic energy needs.

The Nation is also facing new challenges from a changing climate. The summer melting of Arctic sea ice has opened up shipping channels and energy exploration options that were inaccessible just a few years ago. The resulting increase in vessel traffic and exploration activities will increase the potential for oil spills to occur in the Arctic. We have learned that many of today's standard approaches to oil spill clean-up and restoration do not apply in the cold Arctic waters, and there is a need for improved understanding and better methods to clean up and restore this fragile environment. In other areas of the country, aging oil infrastructure in coastal areas will be susceptible to sea level rise and more frequent and violent storms in U.S. coastal areas.

The best action to take is to prevent oil spills from occurring. However, despite our best prevention efforts and advances that have been made over the past twenty years, there are still thousands of spills every year. Most are small spills less than 100 gallons. However, the DM932 barge spill in the Mississippi River in 2008 is a stark reminder that large spills still occur, and the 2007 *Cosco Busan* incident in San Francisco Bay reminds us that large volumes of oil do not have to be spilled for an incident to cause significant regional impacts. Once oil is released into the marine environment, our goal is to quickly and effectively mitigate and restore any harmful effects. An effective response, based on solid science and smart decision-making, reduces environmental and socioeconomic impacts as well as clean-up costs.

NOAA'S ROLE IN RESPONSE

While several other agencies, including the Department of Homeland Security, the Department of the Interior, and the Environmental Protection Agency, have important roles in oil spill clean-up and oil spill research, my testimony will focus specifically on NOAA's roles. When oil is spilled into the marine environment, NOAA has three critical roles mandated by the *Oil Pollution Act* and the National Contingency Plan:

1. Serve as a single conduit for scientific information to the Federal On-Scene Coordinator to provide trajectory predictions for spilled oil, overflight obser-

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[1] USDOT Freight Analysis Framework National Summary: 1998, 2010, 2020.

vations of oil on water, identification of environmental areas that are highly valued or sensitive, and shoreline surveys of oil to determine clean-up priorities.

2. Conduct a natural resource damage assessment with the goal of restoring any ocean resources harmed by the spill. This includes fulfilling the role of Natural Resource Trustee for impacted marine resources.
3. Represent Department of Commerce interests in spill response decision-making activities through the Regional Response Team.

NOAA serves the Nation by providing expertise and a suite of products and services critical for making science-based response decisions that prevent further harm, restore natural resources, and promote effective planning for future incidents. Federal, State, and local agencies across the country called upon NOAA's Office of Response and Restoration for scientific support 169 times in 2008. Most of these calls were related to oil spills.

NOAA's Scientific Support Coordinators are located around the country in U.S. Coast Guard (USCG) Districts, ready to respond around the clock to any emergencies involving the release of oil or hazardous materials into the oceans or atmosphere. During an oil spill, the Scientific Support Coordinator delivers scientific support to the USCG in its role as Federal On-Scene Coordinator. Using experience, expertise, and state-of-the-art technology, NOAA forecasts the movement and behavior of spilled oil, evaluates the risk to resources, conducts overflight observations and shoreline surveys, and recommends protection priorities and appropriate clean-up actions. NOAA also provides spot weather forecasts, emergency coastal survey and charting capabilities, aerial and satellite imagery, and real-time coastal ocean observation data to assist response efforts. Federal, State, and local entities look to NOAA for assistance, experience, local perspective, and scientific knowledge.

Effective spill response also depends on effective planning and preparation, which is how NOAA responders spend the bulk of their time between spills. NOAA promotes preparedness by representing the Department of Commerce on the National Response Team and working closely with regional response teams and local area committees to develop policies on dispersant use, best clean-up practices, communications, and ensuring access to science-related resources, data and expertise. In addition, NOAA enhances the state of readiness by conducting training for the response community and developing better response tools including trajectory models, fate models, and integrating improved weather and ocean observing systems data into spill trajectory forecasts.

NOAA'S ROLE IN DAMAGE ASSESSMENT AND RESTORATION

Oil spills affect our natural resources in a variety of ways. They can directly impact our natural resources, such as the oiling of marine mammals. They can also diminish the ecological services provided by these natural resources, such as when oil degrades a coastal marsh that provides habitat for fish and wildlife. Oil spills may also diminish how we use these resources, by affecting fishing, boating, beach going, and wildlife viewing opportunities.

As the lead federal trustee for marine resources, NOAA is mandated by the *Oil Pollution Act* (OPA) to achieve full compensation for the public for injuries to natural resources resulting from an oil spill. OPA encourages compensation in the form of restoration and this is accomplished through the Natural Resource Damage Assessment process—by assessing injury and then developing a restoration plan that appropriately compensates the public for the injured resources. NOAA scientists and economists provide the technical information for natural resource damage assessments and work with other trustees and responsible parties to restore resources injured by oil spills. To accomplish this effort NOAA experts collect data, conduct studies, and perform analyses needed to determine whether and to what degree coastal and marine resources have sustained injury from oil spills. They determine how best to restore injured resources and develop the most appropriate restoration projects to compensate the public for associated lost services. Over the past 20 years, NOAA and other natural resource trustees have recovered over $440 million from responsible parties for restoration of wetlands, coral reefs, oyster reefs, and other important habitats.

The successful recovery of injured natural resources depends upon integrated spill response and restoration approaches. The initial goals of a response include containment and recovery of floating oil because recovery rates for floating oil can be quite high under certain conditions. As the oil reaches the shoreline, clean-up efforts become more intrusive and oil recovery rates decline. At this point it becomes important to recognize that further spill response can cause additional harm to natural resources and actually slow recovery rates. Such decision points need to be understood so that cost effective and successful restoration can take place. Further research on clean-up and restoration techniques and the recovery of environmental and human services after spills can improve such decision-making.

NOAA'S ROLE IN OIL SPILL RESEARCH

Strong science is critical to effective decision-making to minimize the economic impacts and mitigate the effects of oil spills on coastal and marine resources and associated communities.

Continued use of science, through robust research and development program, can improve the effectiveness of spill response efforts and habitat restoration.

In 1990, the OPA recognized the need for research by creating the Interagency Coordinating Committee on Oil Pollution Research to establish a coordinated effort among industry, universities, and agencies to address oil pollution research and development. While some funding has been provided through various State and federal agencies and industry, the comprehensive research and development envisioned by OPA has not been achieved. Oil spill research in the private and public sectors has declined over the years in part because larger spills have become less frequent. While research has resulted in advancement in some technologies, our nation's capabilities can be strengthened.

OPA does grant NOAA the authority to carry out research and development. NOAA's most recent effort in oil spill research was through a partnership with the Coastal Response Research Center (CRRC) at the University of New Hampshire. Research at the CRRC focused on improving decision-making capabilities for dispersant use on oil spills, improving predictive and response capabilities for deepwater well blowouts, and improving response in cold-water environments through national and international collaborations. This research also included collaboration with government, industry and international partners to identify plausible disaster scenarios facing the Arctic, outlined how NOAA and its partners would respond, and determined response and research needs. We have worked with our partners to address other pressing issues including submerged oil, human dimensions of spills, assessment and restoration of ecosystem services, environmental tradeoffs, integrated modeling, and methods associated with *in situ* burning approached in coastal marshes to minimize further injury to resources.

PRIORITY RESEARCH AREAS FOR THE NATION

NOAA has seen the value of a strong and successful partnership with the academic community to focus on priority program-driven oil spill research areas. Future research activities that would benefit NOAA oil spill response and restoration include:

- Improved oil spill modeling to better predict where the oil will go in the environment. We currently lack the modeling capability to determine how oil will behave in icy environments or when it sinks below the surface. Improving our fate and trajectory models even a small amount may result in improved response efficiency and considerable reduction in spill costs. The FY 2010 President's Request includes resources to address modeling needs, with a particular focus on three-dimensional models.
- Better response methods and improved capabilities for response in cold water spills, and baseline understanding of Arctic resources for conducting injury assessments and developing restoration strategies. This is important as Arctic development leases are issued and marine transportation increases.
- Better understanding of climate change on existing ecosystems and how this will directly affect long-term restoration options.
- Better use of remote-sensing technologies, Unmanned Aerial Vehicles, and an improved ability to access and use real-time observation systems to optimize clean-up operations. For example, when oil spreads across the water it does not do so in a uniform manner. Oil slicks can be quite patchy and vary in thickness. The effectiveness of response options the booms, skimmers, and dispersants—depends on whether they are applied in the areas of the heaviest oil. NOAA's trajectory modeling and visual observations though overflights can help direct the application of spill technologies, but remote sensing technology could be used to more effectively detect oil, determine areas of heaviest amounts of oil, and then use this information to direct oil skimming operations and increase the recovery of spilled oil. Remote sensing technology could have also assisted in the *Cosco Busan* oil spill. Traditional methods of visual observation can be difficult at night or in low visibility conditions, as was the case in the *Cosco Busan* response.

- Improved use of real time data on currents, tides and winds in driving oil predictions models. As the Integrated Ocean Observing System generates more data from technological advances like high frequency radar, oil location predictions can be improved by pulling these observations into trajectory models in real time. To accomplish this will require research to work out effective protocols and procedures.
- Improved understanding of the long-term effects of oil on sensitive and economically important species.
- Incorporation of impacted communities into the preparedness and response processes to address the human dimensions of spills, including social issues, community effects, risk communication methods, and valuation of natural resources.

EXAMPLES OF THE IMPORTANCE OF RESPONSE, RESTORATION, AND RESEARCH

I would like to illustrate some examples of two significant oil spills (*Athos I* and *M/V Selendang Ayu*), NOAA's role in these responses, and the issues and challenges encountered during the response to these oil spills.

M/V Selendang Ayu

On December 7–8, 2004, the cargo vessel *M/V Selendang Ayu* lost power, ran aground and broke in half on the shore of Unalaska Island, Alaska, losing her 60,000 ton cargo of soybeans and spilling approximately 335,000 gallons of fuel oil. During the response, NOAA participated in aerial observations and mapping of floating and beached oil, provided trajectory analysis, conducted shoreline assessments to determine the magnitude and extent of the contamination, as well as provided on-scene weather information, including the establishment of an emergency remote weather station and the provision of a dedicated on-scene meteorologist. Since the initial response NOAA has continued to work with the other natural resource trustees and the responsible party to conduct a natural resource damage assessment, and evaluate restoration alternatives.

The remote location of the spill along with the difficult conditions (e.g., weather, cold water, etc.) posed many challenges to the response. These challenges are similar to ones we may face in the future in responding to spills in the Arctic. The issues encountered in the *Selendang* spill response demonstrate the importance and need for sustained oil spill research. The Port of Dutch Harbor on Unalaska Island is the largest fishing port in the United States and has the largest Alaskan native subsistence community in the Aleutians. NOAA, U.S. Fish and Wildlife Service, and the State of Alaska worked with the local community to address subsistence and seafood safety concerns. Any real or perceived contamination of fisheries products with oil has the potential to disrupt both the local community and worldwide markets. Better knowledge and understanding of the short-term and long-term potential impacts of both floating oil and submerged oil on fisheries would have been beneficial in the response and the injury assessment decision-making.

Due to the severe winter weather conditions, the response was halted during the winter. The USCG continued to conduct periodic overflights to monitor the wreck. The vessel was in poor condition and was still carrying a large quantity of oil, and had the vessel lost that oil it may have taken 24 hours or more before that was detected through overflights. Improved remote sensing technologies could have helped monitor the wreck and detect any spilled oil.

The Scientific Support Coordinator provided input on environmental issues to the Unified Command, including technical matters related to potential dispersant use. While dispersants were readily available, the Unified Command decided not to use dispersants because of uncertainty about the effectiveness of the available dispersants on the type of oil spilled, and the potential environmental impacts. Dispersants are rarely used in spill response, mainly due to our lack of understanding of the environmental impacts of dispersants. While there have been advancements in the application of dispersants and their efficacy of dispersion once applied, there is still a gap in research to determine the long-term fate and effects of dispersants on marine life.

Another issue that arose was the fate of residual oil. This is a common issue with large oil spills, and has certainly been the case with the *Exxon Valdez* oil spill. Twenty years after the *Exxon Valdez* spill there is still residual oil remaining on the Alaskan shoreline. When oil is spilled into the water, a goal is to minimize the environmental impacts. One method to do this is through rigorous clean-up techniques to remove oil from the shoreline. However, some of these techniques can actually do more environmental harm than leaving the oil in place. We need to better understand the fate of lingering oil—where will it persist, in what types of environments, what are the impacts to the environment from this remaining oil, as well as the effects of low-level chronic exposure on birds and mammals. This type of information is critical as decisions are made in the clean-up operations and to determine the potential trade-offs in using one clean-up technique versus another. This information is also critical to how we assess the injury to natural resources from the spill and restoration options. Further research in this area to improve decision-making can reduce the overall environmental impacts and clean-up costs.

M/T Athos I

On November 26, 2004, the *M/T Athos I,* a 750-foot tanker, hit a submerged object in the Delaware River near Philadelphia, PA, spilling approximately 265,000 gallons of heavy oil. The oil spread down river, ultimately oiling 57 miles of Pennsylvania, New Jersey, and Delaware shorelines. In addition to surface and shoreline oiling, a portion of the oil migrated below the water surface, complicating response and assessment efforts. During the response, NOAA provided its traditional support: oil trajectory analysis, weather forecasts, identification of sensitive resources at risk, coordination of shoreline impact assessment, recommendations on environmentally appropriate clean-up techniques, and seafood safety consultation.

The spill closed the Delaware River to commercial vessel traffic for over a week. The submerged oil resulted in contamination of water intakes and the closure of the Salem Nuclear Power Plant. The detection of submerged oil was a critical economic issue in this case, essential to the reopening of the port and the reactivation of the power plant.

The *Athos I* incident is a reminder that there is still a need to sustain an integrated spill response and restoration research program. NOAA's response to the *Athos I* spill highlighted the need for improved understanding of the transport and fate of submerged oil, and the need to develop more efficient technologies for submerged oil detection, tracking, and modeling. The *Athos I* response also highlighted the need for additional research on ways to collect submerged oil and/or protect locations from it. Without reliable technologies for prediction and detection, the Federal On-Scene Coordinator and his science staff are placed in the position of "proving a negative" to the public in order to ensure no continued threat. Such "proof" adds time and expense to the response and can substantially raise the overall costs of clean-up. NOAA's research efforts continue to address these concerns. Better modeling and understanding of submerged oil behavior could have prevented the plant closure.

CONCLUSION

Thank you for the opportunity to discuss with you NOAA's important role in oil spill response and resource restoration. NOAA's expertise is critical to prevent further harm, restore natural resources, and aid planning and response decision-making associated with oil spills. Sound science is the foundation for effective spill response and restoration decision-making. It is critical that we continue to invest in high priority scientific research to develop the methods and techniques necessary to improve the effectiveness of spill response and restoration. I am happy to answer any questions that you may have.

BIOGRAPHY FOR DOUGLAS R. HELTON

I am the Incident Operations Coordinator for NOAA's Emergency Response Division. I help manage NOAA's scientific support team during oil and chemical spill responses and ensure that NOAA products and services are provided quickly and are useful to the U.S. Coast Guard and other on-scene responders. I respond on-scene to incidents and I have worked on spill events and emergency response efforts in almost all coastal states, ranging from Maine to Alaska to Guam. Between incidents, I manage various preparedness projects including directing the Division's prime support contract. I also work with the NOAA coral and NOAA Marine Debris Programs on the problem of grounded and derelict vessels in coastal environments. I spent several month following Hurricane Katrina working on a U.S. Coast Guard vessel salvage and wreck removal team.

I am currently in NOAA's leadership development program. Over the past 18 months I have had rotational assignments as the Acting Director of NOAA's Marine Debris Program and with the Port of Seattle's "Green Port" team. I also completed a 6 month detail with the Senate Commerce Committee. In that capacity I worked on several bills including Ballast Water Management, Coral Reef Conservation, Oil

Pollution, Climate Change, Coast Guard reauthorization, and other ocean-related legislation.

Prior to my current position, I headed NOAA's Damage Assessment Center (DAC) which allows NOAA to place scientists on-scene quickly after an oil or chemical spill to collect perishable biological and economic data and to initiate damage assessment studies to support legal claims for restoration. I received a BA from Reed College in Portland, OR in 1985 and an MS from the University of Washington School of Fisheries in 1991. I started my NOAA career as a John Knauss Sea Grant Fellow in 1991–1992.

Chairman BAIRD. Thank you very much, Mr. Helton.

Dr. Venosa.

STATEMENT OF DR. ALBERT D. VENOSA, DIRECTOR, LAND REMEDIATION AND POLLUTION CONTROL DIVISION, NATIONAL RISK MANAGEMENT RESEARCH LABORATORY, OFFICE OF RESEARCH AND DEVELOPMENT (ORD), U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Dr. VENOSA. Thank you, Mr. Chairman. Good afternoon, everyone. I am Dr. Albert Venosa, Director of the Office of Research and Development's Land Remediation and Pollution Control Division and National Risk Management Research Lab in Cincinnati. It is a pleasure to be here today to discuss EPA's Oil Spill Research Program, its past accomplishments, and its future research plans.

I have been with the Agency for over 40 years and for the last 20 I have led EPA's Oil Spill Research and Development Program. Its objective is to provide environmental managers with tools, models, and methods needed to mitigate the effects of oil spills in all ecosystems with emphasis on the inland environment. The research includes development of practical solutions to mitigate spill impacts on fresh water and marine environments, development and publication of remedial guidance for cleanup and restoration of oil-impacted environments, and determination of the fate and effects of oil contamination in the environment through effective modeling of oil transport in a variety of settings, especially river networks.

So why does oil spill research need to be continued? The major source of inland oil spills in the U.S. is from ruptured pipelines and above-ground storage tanks, ASTs. Although larger oil spills from oceangoing tanker accidents have been on the decline over the last several decades, I believe that the number of inland oil spills may actually increase due to the greater emphasis on domestic oil production and higher volume generation of alternative fuels such as biofuels, which will be stored in ASTs.

So the spill threat continues even without consideration of domestic alternative fuel development. Little is known about the effect of spills of biodiesel, emerging biofuels, or byproducts from the manufacturer, from their manufacturer on watersheds. So consequently research is needed to continue to find effective ways to respond not only to traditional petroleum spills, but also to spills of non-traditional alternative fuels and fuel blends.

EPA's past research has resulted in new protocols for testing the effectiveness of commercial oil spill treating agents, guidance documents for implementing bio-remediation in different environments, a clearer understanding of the impact and persistence of non-petroleum oil spills in the environment, and development of new spill treatment approaches.

Ten years ago we began conducting research on non-petroleum oils such as vegetable oils and animal fats. This anticipatory research investment will be invaluable as the national emphasis on fuels development gains traction.

Why? Because vegetable oils and animal fats are the primary feedstocks for biodiesel production. Contrary to some claims, our research has shown that edible oils are not as biodegradable as sugar in the environment because of the complexity of chemical interactions along saturated and unsaturated fatty acids.

The future research that we will do will involve the study of multiple fuel types and blends resulting from passage of the *Energy Independence and Security Act of 2007.* Last year in anticipation of this we initiated the study of the different types of biodiesel and biodiesel, petro-diesel blends. An important byproduct in the production of biodiesel is glycerin, and we need to understand how to deal with glycerin spills in flowing streams, because they have already resulted in large fish kills in several of our regions.

As for arctic spills, next year EPA plans to partner with the Canadian government to conduct both pilot and field scale research, dispersant research in icy waters. Protection of this environment will become more critical as global climate change affects the integrity of the glacial ice fields in the arctic.

So in conclusion then, EPA's Oil Spill Research Program is an applied practical program based on high-quality, sound science. It promises to provide answers to real important, real and important emergency spill response and environmental protection challenges, especially in the area of emerging alternative fuel sources. Our research informs EPA regulatory decision-making and policy development for oil spill prevention, preparedness, and response programs.

In the 20 years I have led this program we have published over 85 peer review journal articles, three guidance documents, and 79 conference proceedings. So it has been a pretty productive and successful program both nationally and internationally.

Thank you for the opportunity to address the Committee. I will be happy to answer your questions.

[The prepared statement of Dr. Venosa follows:]

PREPARED STATEMENT OF ALBERT D. VENOSA

Good afternoon. I am Dr. Albert D. Venosa, Director of ORD's Land Remediation and Pollution Control Division in EPA's National Risk Management Research Laboratory, Cincinnati, Ohio. It is a pleasure to be here today to discuss EPA's oil spill research program, its past accomplishments, and future research plans.

For the past 20 years, I have led EPA's oil spill research and development program to conduct basic and applied research in both the laboratory and the field in the area of spill response technology development. I was an EPA team leader in the *Exxon Valdez* bioremediation project in 1989 and 1990. I also conceived and led an important controlled oil spill project on the shoreline of Delaware Bay in 1994[1], which demonstrated statistically that bioremediation with simple inorganic nutrients enhances the biodegradation rate of crude oil on a marine shoreline compared to natural attenuation without amendments. I repeated a similar experiment in 1999[2] on a Quebec freshwater wetland and again in 2001[3] on a Nova Scotia salt marsh in collaboration with our Canadian government partners. In addition to those field studies, I led a research team in developing laboratory protocols to test the effectiveness of commercial bioremediation agents and chemical dispersant products for use in treating oil spills[4–6]. I have conceived and led numerous other studies to understand how best to respond to and mitigate oil spills on land.

The Environmental Threat of Oil Spills

Why does oil spill research need to be continued? From 1980 to 2003, one study[7] (*http://www.epa.gov/OEM/docs/oil/fss/fss06/etkin_2.pdf*) reported more than 280 million gallons of oil (about 12 million gallons/year) were discharged to the inland waters of the U.S. or its adjoining shorelines in about 52,000 spill incidents. Even though larger oil spills from ocean-going tanker accidents have been on the decline over the last several decades, I believe the number of inland spills will likely increase due to greater emphasis on domestic oil production and higher volume production of alternative fuels such as biofuels, as our nation continues to address its independent energy security needs. Waterborne transportation of oil in the U.S. continues to increase, and the volume of oil spilled from tank barges has remained constant at approximately 200,000 gallons spilled each year. EPA is also concerned about spills from pipelines and above ground storage tanks that could contaminate surface and/or ground waters. These are the major source of inland oil spills nationwide[7]. So, the spill threat continues even without consideration of domestic alternative fuel development. An oil discharge to the waters of the U.S. can affect drinking water supplies; sicken and/or kill fish, animals, and birds; foul beaches and recreational areas; and persist in the environment, harming sensitive ecosystems. Little is known about the effect of spills of biodiesel, emerging biofuels, or by-products from their manufacture on watersheds. Consequently, research is critically essential not only to continue to find effective ways to mitigate and respond to petroleum spills but also to understand the potential adverse human and environmental consequences of alternative fuels and non-petroleum oils and to develop effective clean-up tools to mitigate any adverse consequences. Recent research on vegetable oils and biodiesel blends suggests that the biodegradability and environmental persistence of these oils is very complex[8]. Developing an understanding of the potential environmental impacts associated with spills of these oils requires fundamental research. Without this understanding, the potential is significant for greater environmental harm if the wrong steps are taken to respond to and mitigate these spills.

EPA's Role in Spill Response

The National Oil and Hazardous Substance Pollution Contingency Plan (NCP) has established a successful oil spill response framework defining the roles of federal agencies, and this has been in effect for 41 years. In addition to EPA's normal role in spill response and planning, the NCP serves as the basis for actions taken in support of the National Response Framework, when Emergency Support Function (ESF) #10 is activated. The National Response Framework is a guide that details how the Nation conducts all-hazards response, from the smallest incident to the largest catastrophe. The Framework identifies the key response principles and the roles and structures that organize national response. ESF #10 provides for a coordinated federal response to actual or potential oil and hazardous materials incidents. EPA or DHS/USCG serves as the primary agency for ESF #10 actions, depending upon whether the incident affects the inland or coastal zone, respectively. For incidents affecting both, EPA is the primary agency and DHS/USCG serves as the deputy. In addition, EPA serves as the ESF #10 Coordinator.

EPA also plays a key role on the U.S. National Response Team (NRT), which is chaired by EPA and vice-chaired by the U.S. Coast Guard. The NRT is an organization of 16 federal departments and agencies responsible for coordinating emergency preparedness and response activities for oil and hazardous substance pollution incidents and provides federal resources, technical assistance, and policy guidance as defined in the NCP. The Science and Technology Committee, which is the NRT's science arm and of which I am a participating member, provides a forum for the NRT to fulfill its delegated responsibilities in research and development. Users of and sometimes collaborators in our research include multi-agency regional response teams, EPA's environmental response team, EPA and Coast Guard federal on-scene coordinators (FOSCs) responsible for oil spill response, and other government agencies such as NOAA, Minerals Management Service (MMS), Fish and Wildlife Service, and states. Not only do these U.S. organizations rely significantly on EPA research results, the international community does as well.

Past and Current Research

The specific objective of EPA's oil spill research program is to provide environmental managers with the tools, models, and methods needed to mitigate the effects of oil spills on ecosystems. The research includes development of practical solutions to mitigate spill impacts on freshwater and marine environments; development of remedial guidelines that address the environment, type of oil (petroleum and non-petroleum oils), and agents for remediation; and modeling fate and effects in the environment. Spill mitigation research includes bioremediation, chemical and physical countermeasures, and ecotoxicity effects. Fate and effects research focuses on modeling the transport of oil in a variety of settings with application to field situations.

The work described above has resulted in new protocols for testing the effectiveness of commercial oil spill treating agents, guidance documents for implementing bioremediation in different environments, a clearer understanding of the impact and persistence of non-petroleum oil spills in the environment, and development of potentially new treatment approaches. Important on-going research is helping to understand oil persistence long after the initial spill incident, such as the *Exxon Valdez* oil that still lingers in certain areas of Prince William Sound, Alaska. This research has conclusively shown that the lingering oil is still quite biodegradable despite persisting for over 20 years in the subsurface. Why is this important? Because, if oil that has been treated after a spill lingers long after the cleanup, then we need to understand if the lingering oil still poses an environmental threat to the habitat and the resources at risk. If it does, we must learn why it still lingers and develop means to remove this lingering oil to safeguard the ecosystem.

Ten years ago, we began conducting research on non-petroleum oil such as vegetable oils and animal fats. This anticipatory research investment will be invaluable as the national emphasis on biofuels development gains traction because vegetable oils and animal fats are the primary feedstocks for biodiesel production. Contrary to some claims, we have found that edible oils are not as "biodegradable as sugar" in the environment because of the complexity of chemical interactions among saturated and unsaturated fatty acids.

Future Research

Biodiesel will play a crucial role in our nation's domestic fuel source development. Future research will include multiple fuel types and blends that result from passage of the *Energy Independence and Security Act of 2007* (EISA), including changes in fuels as a result of the Renewable Fuel Standard (RFS) Program. We initiated an important project in 2008 to study the comparative biodegradability of soybean oil-based biodiesel blends ranging from B0 (pure petrodiesel) to B100 (pure biodiesel). We are initiating testing of other types of biodiesels consistent with anticipated alternative fuel feedstock usage in the U.S. An important by-product in the production of biodiesel is glycerin, and we need to understand how to deal with spills of glycerin in flowing streams (spills have already caused large fish kills). Ethanol/gasoline blends, their fate and transport in freshwater bodies, and our need to understand the spill impacts of these blended fuels are another high priority research area as greater quantities of blended fuels and potentially greater ethanol percentages are handled. EPA is the only federal agency actively engaged in researching this particular topic. Second generation biofuels will be studied in the near future, such as biobutanol, whose properties are more similar to gasoline than alcohol.

The behavior of other oil types, including synthetic oils and lubricants, has not been characterized scientifically. An important topic not previously addressed in our research program is a mixed spill incident (e.g., a biofuel and an organic chemical). We need a better understanding of the consequences of such scenarios to help FOSCs from both the EPA and the Coast Guard respond appropriately.

As for spills that occur near or in Arctic regions, EPA plans to pursue partnering with the Canadian government to conduct pilot-scale dispersant research in icy waters at a jointly owned wave tank facility in Nova Scotia and field research on dispersant effectiveness and use in Arctic waters. Protection of this environment will become more critical as global climate change affects the integrity of the glacial ice fields in the Arctic.

Finally, EPA's Environmental Response Team (ERT) plays a key role in testing and validating monitoring equipment in collaboration with the MMS at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) Facility in New Jersey to understand oil monitoring systems under the Special Monitoring and Response Technologies (SMART) protocol. This interaction allows ERT and the Coast Guard to be trained on oil spill monitoring equipment for detecting oil in the water column. This understanding is important in light of the Coast Guard's Response Capabilities rule coming out soon dealing with dispersant usage.

Summary and Conclusions

In conclusion, I want to emphasize that EPA's oil spill research program is an applied, practical program that seeks to provide answers to real and important emergency spill response and environmental protection challenges based on high quality, sound science. Our research informs EPA's regulatory decision-making and policy development for oil spill prevention, preparedness, and response programs and the

National Response Team. EPA's oil spill research work is vitally important to the protection of the environment from the harm associated with oil spills. So, it is vital that EPA's R&D program continue to provide its knowledge and expertise in spill response and prevention. In the 20 years that I have led this program, we have published over 85 peer-reviewed journal articles, three guidance documents, and 79 conference proceedings papers. Thus, the research program has been highly productive and successful both nationally and internationally.

Thank you for the opportunity to address the Committee. I am happy to answer your questions.

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BIOGRAPHY FOR ALBERT D. VENOSA

Dr. Venosa is the Director of the Land Remediation and Pollution Control Division, National Risk Management Research Laboratory in EPA's Office of Research and Development. He manages and directs the Division's science and research programs and conducts research in his area of expertise, which is oil spill remediation and mitigation. From 1990 to 2009, Dr. Venosa served as Senior Research Scientist and Program Manager, Oil Spill Research Program. Dr. Venosa's 20 years of work in this area include membership on the science team for the Alaska Oil Spill Bioremediation Project involved with assessing effectiveness of nutrient formulations in the field for stimulating enhanced biodegradation of contaminated shorelines in Prince William Sound. In 1990 he led an independent field study to determine if commercial bioremediation agents could accelerate biodegradation in multiple field plots. From 1986 to 1988, he served as EPA's Chairman of the Pathogen Equivalency Committee in the sludge research program, and for the previous 18 years he was the National Program Manager for ORD's Municipal Wastewater Disinfection Program.

Dr. Venosa holds a Doctor of Philosophy degree in Environmental Science, a Master of Science degree in Environmental Engineering, and a Bachelor of Science degree in Microbiology from the University of Cincinnati. His research interests and expertise include developing protocols for testing the effectiveness of commercial bioremediation products for biodegrading crude oil in seawater; developing protocols for chemical countermeasure products such as dispersants, surface washing agents, and solidifiers in freshwater, beach sediments, wetlands, and soils; conceiving methods for microbiological and chemical analysis of oil spill remediation activities; and advancing our knowledge in the area of improved scientific and practical understanding of the mechanisms of biodegradation of petroleum hydrocarbons, especially polycyclic aromatic hydrocarbons. Dr. Venosa has received numerous awards for his work and has been lead author on 37 out of a total of 121 peer-reviewed scientific publications throughout his career.

Chairman BAIRD. Thank you, Dr. Venosa.

Mr. Watson.

STATEMENT OF REAR ADMIRAL JAMES A. WATSON, DIRECTOR OF PREVENTION POLICY FOR MARINE SAFETY, SECURITY AND STEWARDSHIP, DEPARTMENT OF HOMELAND SECURITY, U.S. COAST GUARD

Admiral WATSON. Good afternoon, Chairman Baird and distinguished Members of the Committee. I am grateful for the opportunity to testify before this committee on the subject of federal oil spill research and development.

The Coast Guard has been the lead federal agency for coastal zone oil and HazMat response since 1968, and I have been personally involved with oil and HazMat prevention and response my entire Coast Guard career. As an engineer and first responder, I value research and development.

In the area of maritime pollution prevention and response in particular, R&D has been a major factor in reducing both the number of major oil incidents and the quantities left in the environment after an accident.

For example, the annual number of oil spills greater than 100 gallons has decreased from over 300 per year to less than 100 since 1996. Simultaneously, recovery rates, which are historically less than 15 percent, are improving. Today we are recovering as much as three times the historic rate due to better planning, more response capacity, and better projections and recovery equipment. I attribute many of these improvements to the collective efforts of government agencies and industry following the passage of the *Oil Pollution Act of 1990*.

OPA 90 created and integrated team-based approach, which successfully leveraged the federal on-scene coordinator leadership attributes of the Coast Guard and the EPA at both the national and local level, as well as the technical and scientific capabilities of NOAA, the Minerals Management Service, U.S. Fish and Wildlife Service, U.S. Navy, State and environmental agencies, and universities nationwide.

The Coast Guard's own research and development center which just recently moved from Groton, Connecticut, to New London, Connecticut, has been included in the collective R&D effort since well before 1990, and continues to be productive in oil and HazMat R&D.

While EPA tends to focus on toxicity and NOAA on oil behavior and impacts and MMS and offshore blowouts, for example, Coast Guard's R&D is currently focused on sensors for aircraft, recovery of submerged oil, and oil and ice and decision-making tools for the responders. This distribution of labor for R&D is being monitored and reported to Congress in accordance with Section 7001 of OPA 90, which established the Interagency Coordinating Committee on Oil Pollution Research. The Coast Guard shares this interagency committee and provides the biannual report to Congress. Coast Guard personnel must stay closely plugged into the various R&D facilities, conferences, and publications to fulfill their duty.

But speaking as a federal on-scene coordinator myself and as a beneficiary of these collective R&D efforts, I can tell you the benefits have far exceeded the cost of participating with this interagency R&D effort. We estimate that a recovery capability increase of 10 percent would have saved over $1 billion in response and environmental damage based on the cost figures since 1992.

Despite past successes, much more R&D is needed. We are just beginning to understand and solve the challenges of submerged oil, oil and ice, dispersed oil, oil in fast currents, and biofuels in water. We are pleased to see other nations and even the maritime industry taking on these challenges.

For example, Norway is conducting a major oil and ice analysis, and oil companies are engaged with Coast Guard engineers in the conceptual stages for high-latitude prevention and response capabilities.

Thank you for the opportunity to testify today. I will be happy to take your questions.

[The prepared statement of Rear Admiral Watson follows:]

PREPARED STATEMENT OF REAR ADMIRAL JAMES A. WATSON

Good Morning Mr. Chairman and distinguished Members of the Committee. It is a pleasure to appear before you today to discuss Coast Guard oil spill response research efforts.

The passing of *Oil Pollution Act of 1990* (OPA 90) represented a significant paradigm shift for the Coast Guard. That historic legislation provided the Nation with the means to immediately access and distribute funding for oil spill response efforts; made the spiller the responsible party with very specific requirements; and provided a process to restore the marine environment to its pre-incident condition. With this legislation came annual funding for the Coast Guard to take the lead in oil spill prevention, response, and research and development.

The Coast Guard continues to appreciate the significance of the *Exxon Valdez* event. After running aground at Bligh Reef and spilling over 10 million gallons of oil into Prince William Sound at Valdez, Alaska, this incident became the catalyst for stricter environmental protections and regulations. For the Nation, and for the Coast Guard, the impacts served as the catalyst for developing a stronger regime to improve the shipment of oil and the way oil spills are handled on the water and in the courtroom. The Coast Guard's research and development program ensures we retain the critical expertise and capabilities to prepare, prevent, and, if necessary, respond and recover from future incidents in an increasingly complex national and global operating environment.

The United States has a comprehensive framework for oil spill prevention, preparedness and response that is fully supported by the Coast Guard's Research and Development Center (R&DC). While several other agencies, including the Department of Commerce, the Department of the Interior, and the Environmental Protection Agency, have important roles in oil spill clean-up and oil spill research, my testimony will focus specifically on the Coast Guard's roles. For more than 25 years, the R&DC has maintained a comprehensive, long-term research program to improve oil spill response technologies. The major focus of the program is to improve the knowledge, technologies and methodologies used for the detection, containment and cleanup of oil spills. I am encouraged by the significant advancements we have made since the *Exxon Valdez* incident and the passage of OPA 90.

Ship designs for tankers are mandated to have double hulls. The OPA 90 phase-out schedule requires existing single-hulled tank vessels be retrofitted with a double hull or phased out of operation by 2015.

A basic tenet of OPA 90 holds that those responsible for oil pollution incidents are liable for clean up costs and compensation damages. Currently over 22,500 vessels carrying oil in U.S. waters hold active Certificates of Financial Responsibility to satisfy this requirement.

Regulations tightened the authorities of the Federal On-Scene Coordinator (FOSC) to oversee spill response as well as preparedness activities at the local level. This is consistent with the Nation's approach to response as represented in the National Response Framework (NRF). In a sense, this approach was well ahead of its time and remains a model for integrating all entities, including private industry, into effective response organizations.

We must be mindful that our Marine Transportation System is the lifeblood of our national economy. Part of that is the shipping of oil. Three months ago, the 900 foot tanker *SKS SATILLA* hit a submerged jack-up rig in the Gulf of Mexico while carrying 41 million gallons of crude oil—nearly four times the amount spilled by the *Exxon Valdez.* Thankfully, the double hull protection put into place by OPA 90 protected the cargo. The stakes remain high. We must continue to work together—the public and private sectors—to ensure we remain prepared and get this right.

We have learned a great deal from the *Exxon Valdez* incident and have made tremendous progress. Work still remains. And these efforts are dependent on our oil spill research efforts. The ideas, standards, and technologies that have emerged from the R&DC benefit all spill responders; federal, State, local and private sector.

U.S. Coast Guard Research & Development Center Accomplishments:

The R&DC has been instrumental in identifying and developing prevention capabilities which have benefited mariners, ship to ship and ship to shore communications, and naval architecture. They have assessed risks associated with human-factors (e.g., crew fatigue and certification requirements), harbor management (e.g., Automated Information Systems), and hull design. Furthermore, the R&DC evaluated alternatives to double-hull designs and provided the foundation for our regulatory initiatives by assessing vessel self-help response methods.

Coast Guard research efforts have also greatly advanced our preparedness in consequence planning and response management. Databases have been developed for response equipment and spill histories and are widely used in contingency planning and commercial product evaluations. Additionally, the Oil Spill Command & Control System (OSC2) prototype has become integrated into the Coast Guard enterprise Command, Control, Communications, Computers, and Information Technology (C4IT) system and the Marine Information for Safety and Law Enforcement system. R&DC efforts to support response management also includes curriculum development, training, and developing safety guidelines for field personnel and the three strike teams, and ensuring Coast Guard personnel are familiar with current and emerging response technologies. The Multi-Agency Team-Building Enhancement System (MATES) that was developed by the R&DC is used for Incident Command System (ICS) training. R&DC is also responsible for developing airborne radar and infrared sensors used for oil spill response operations.

Spill Detection and Surveillance

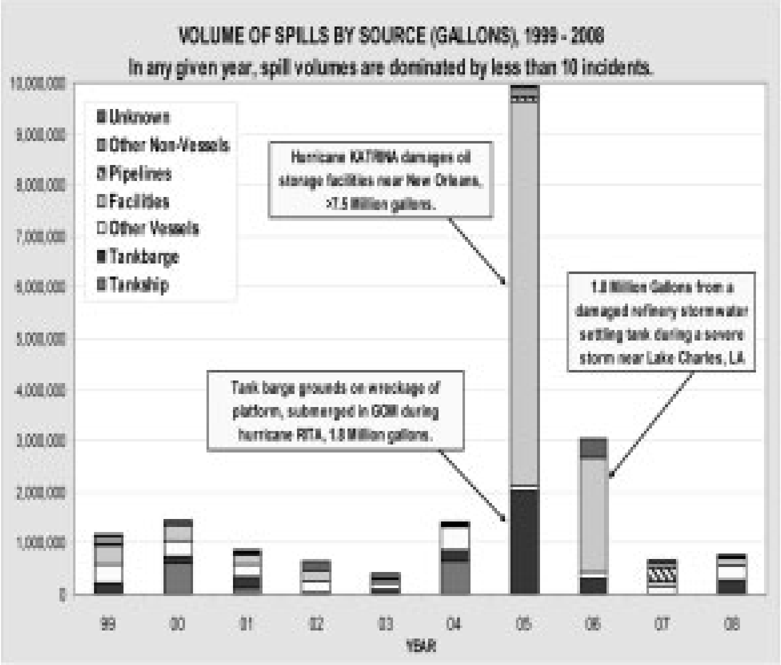
The R&DC has provided the Coast Guard with advanced oil containment and recovery countermeasures. Immediately after *EXXON VALDEZ,* the R&DC provided the critical technical information requirements, fielded prototypes, and tested the first articles of modern oil spill response equipment for the Coast Guard's National Strike Force. The Vessel of Opportunity Skimming System (VOSS) is a unique pre-positioned recovery system that is designed for both Coast Guard cutters and private sector commercial vessels. The R&DC has also developed the Spilled Oil Recovery System (SORS) for the 16 Coast Guard Juniper Class buoy tenders. Other recovery and countermeasure technologies include: (1) fast-water response boom and skimmers; (2) temporary storage devices; (3) oil/water separation systems; (4) *in situ* burning; and (5) technology capability decision support.

Testing fast-water technologies

The R&DC partners with other governmental agencies and the private sector. The Coast Guard helped expand the Nation's testing infrastructure by re-establishing the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) in Leonardo, New Jersey, in cooperation with the Minerals Management Service.

In-situ burn test

Over the last twenty years the Nation has seen a decrease in the annual number of spills over 100 gallons (per 100 million tons shipped); 25 spills met this criteria in 2002 and only 19 in 2007. The following graph shows 10 years of data on the total amount spilled by source. From 1999 to 2007 (the latest available data), an average of only three gallons of oil were spilled for every one million gallons of oil transported over the inland river system. This is due to the significant increase over the last 20 years in federal and industry partnerships supporting maritime oil transportation, the application of OPA 90 standards and safeguards, and enhanced prevention and response capabilities.



The Coast Guard continues to lead the National Response System in research and development. In addition to these efforts with federal and State agencies, we have fostered strong partnerships with vessel owners, facility operators, Oil Spill Removal Organizations, and academia. The oil spill research and development conducted through the U.S. Coast Guard R&DC and its partnerships is positioned ideally in a research-prevent-respond system. By adopting the latest response tactics, techniques, and procedures fostered and facilitated through R&D efforts, our new Deployable Operations Group can tailor adaptive force packages—including Coast Guard National Strike Force personnel—to meet any maritime response need. Additionally, the U.S. Coast Guard Marine Safety Laboratory (MSL) provides forensic oil analysis and expert testimony in support of the oil pollution law enforcement efforts for Marine Investigators, Department of Justice, and other federal agencies. Finally, our National Pollution Funds Center ensures the Oil Spill Liability Trust Fund is ready to finance rapid, response and recovery. Most importantly, the financial responsibility has been placed on the polluters. Since OPA 90 was enacted, over $234 million has been recovered and returned to the Fund.

Oil spill prevention and response actions need proven techniques, technologies, and training. Continued investment in research and development funding is crucial to developing the tools needed for the variety of situations encountered—before they are needed.

We are positioning ourselves to meet future challenges. One example is the Arctic. The Commandant has previously stated, “there is water where there was once ice and the Coast Guard has a responsibility for it.” As we develop our operating requirements to meet the mandates of the NSPD–55/HSPD–25, Arctic Presidential Decision Directive, it is clear our country needs the specialized capability of harsh environment oil spill response. As Arctic ice recedes, opening up new shipping routes and new areas for energy exploration, we must be aware of the economic and environmental implications. We have made significant progress, but there is still much left to be done to address future conditions. In the upcoming years, we must address the more challenging responses associated with harsh environments such as submerged oil and oil in or under ice.

I appreciate Congressional support for our oil spill response research and development and look forward to upcoming discussions on the future of the Coast Guard’s service to America. Thank you for the opportunity to testify today. I look forward to your questions.

BIOGRAPHY FOR REAR ADMIRAL JAMES A. WATSON

Rear Admiral James Watson is currently Director of Prevention Policy for Marine Safety, Security and Stewardship, Coast Guard Headquarters, Washington DC. Previous to this assignment he served as Chief of Staff of the Seventh Coast Guard District in Miami, FL and Chief, Office of Budget and Programs, Coast Guard Headquarters. Prior field assignments include: Commanding Officer Marine Safety Office Miami (2001–2004), Commanding Officer Marine Safety Office San Diego (1995–1998), Executive Officer Marine Safety Office Savannah (1992–1995), Chief of Port Operations Marine Safety Office Puget Sound (1989–1992), and Engineering Officer USCGC Bibb (1978–1980). Headquarters staff assignments have included: Program Reviewer—Office of Budget and Programs (1998–2000), Staff Naval Architect—USCG Marine Safety Center (1986–1989), Staff Engineer—Marine Technical and Hazardous Materials Division (1980–1983).

Rear Admiral Watson graduated from the Coast Guard Academy in 1978 with a Bachelor of Science in Marine Engineering. In 1985 he earned two Master of Science degrees from the University of Michigan, one in Mechanical Engineering and the other in Naval Architecture. In 2001 he graduated from Industrial College of the Armed Forces with a Master's degree in Strategic Studies.

Rear Admiral Watson has been a member of the Society of Naval Architects and Marine Engineers since 1978. He was recognized as the Southeastern United States Propeller Club Person of the Year in 2004. His personal military awards include two Legion of Merits, two Meritorious Service Medals, and six Coast Guard Commendation Medals.

Chairman BAIRD. Mr. Edinger.

STATEMENT OF MR. STEPHEN L. EDINGER, ADMINISTRATOR, CALIFORNIA DEPARTMENT OF FISH AND GAME, OFFICE OF SPILL PREVENTION AND RESPONSE

Mr. EDINGER. Mr. Chairman and Members of the Committee, thank you for the opportunity to testify before you today regarding California's experience and perspective on the status of oil spill response technologies. I am the Administrator of the Office of Spill Prevention Response, also known as OSPR. I oversee more than 200 employees dedicated to protecting California's habitats and wildlife from the devastating effects of pollution.

OSPR was established by the *Lempert-Keene-Seastrand Oil Spill Prevention Response Act of 1990* following the *Exxon Valdez* oil spill in 1989, and the oil trader spill in southern California in 1990. OSPR is one of the few State-level entities in the Nation that has both major pollution response authority and public trustee authority for wildlife and habitat.

OSPR has a legislative mandate to ensure that California's natural resources receive the best protection through oil spill prevention, preparedness, response, and restoration. I am required to consider using processes that are currently in use anywhere in the world to obtain the best achievable technology.

Today I will share some of my observations from the November 7 motor vessel *Cosco Busan* oil spill in San Francisco Bay. I will emphasize some of the gaps in the oil spill technologies that remain. I will highlight some of the effective oil spill technologies utilized by OSPR that were developed as a result of the enactment of State and federal oil spill legislation.

On the morning of November 7, 2007, the motor vessel *Cosco Busan,* a 900-foot container ship, departed the port of Oakland with visibility estimated at less than one-fourth nautical mile. The

Cosco Busan collided with one of the towers of the San Francisco Bay Bridge, resulting in the breach of three tanks, spilling 53,000 gallons of bunker fuel in the San Francisco Bay.

In the following weeks, 43 percent of the oil spilled into the Bay was recovered. While the response to the *Cosco Busan* oil spill was a success, improvements in technologies could have increased recovery of oil and protection of the environment.

Two technologies that might have increased oil recovery include oil detection during reduced visibility or nighttime conditions and oil containment in high-velocity environments. Oil recovery is hampered during times of reduced visibility. As demonstrated during the *Cosco Busan* response, fog hindered accurate trajectory analysis and on-the-water recovery. We lack a critical tool to detect concentrations of oil during periods of restricted visibility.

About booming. Conventional containment and exclusion booms begin to fail when currents exceed three-fourths of a knot. We need a deployable boom that operates effectively in complex, high-velocity currents that are frequently encountered in the coastal environments.

While I mentioned two technologies that need improvement, there are examples of emerging technologies utilized by OSPR. One is multi-spectral and thermal imaging. This imaging technology uses a combination of sensors to capture imagery from wavelengths outside of the human visible light range. This imaging system has enabled rapid oil spill mapping and far greater quantitative and geographical accuracy than was possible using only visual observations.

And the other is high-frequency radar surface current monitoring. Along the California coastline high-frequency radar stations record ocean currents. Surface current data were used extensively during the *Cosco Busan* response to create trajectories, using real-time conditions. These trajectories aided in the identification and protection of environmentally-sensitive sites at risk.

About our role in federal research and development, we would support a continued and increased role with respect to identification of research priorities and practical application of new methods and technologies.

In conclusion, OSPR and the State of California recognize the need for continued improvement in the prevention and response to oil spills. OSPR is committed to utilizing the best achievable technologies as required by statute to provide for the best achievable protection of the marine environment. We support federal research efforts to provide or to improve and develop technologies that address these issues.

Again, I would like to thank you for the opportunity to address the Subcommittee. I would be happy to respond to any questions you may have.

[The prepared statement of Mr. Edinger follows:]

PREPARED STATEMENT OF STEPHEN L. EDINGER

Mr. Chairman and Members of the Committee, thank you for this opportunity to testify before you today regarding California's experience and perspective on the status of oil spill response technologies.

I am Stephen Edinger, Administrator for the California Department of Fish and Game, Office of Spill Prevention and Response (OSPR). I was appointed as Administrator by Governor Arnold Schwarzenegger last November. Prior to taking this appointment, I spent 28 years in law enforcement, working for State and federal agencies, protecting the natural resources of California. I have investigated or served as the incident commander on hundreds of pollution events across California. Today, I oversee more than 200 employees dedicated to protecting California's habitats and wildlife from the devastating effects of pollution.

OSPR was established by the *Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990* following the *Exxon Valdez* oil spill in 1989 and the American Trader spill in Southern California in 1990. OSPR is one of the few State-level entities in the Nation that has both major pollution response authority and public trustee authority for wildlife and habitat.

OSPR has a legislated mandate to ensure that California's natural resources receive the best protection through oil spill prevention, preparedness, response and restoration. Specifically, I am required to provide for the "best achievable protection" which is defined as the highest level of protection that can be achieved through both the use of the best achievable technology and those manpower levels, training procedures and operational methods that provide the greatest degree of protection achievable. Additionally, I am mandated to consider using processes that are currently in use anywhere in the world to obtain the "best achievable technology."

I am proud of OSPR's close collaboration with federal partners. Our relationships with the U.S. Coast Guard, U.S. Environmental Protection Agency, U.S. Minerals Management Service (MMS) and other federal natural resource trustees have helped shape OSPR into the premier spill response program in the Nation. We work closely with these agencies in a variety of efforts including planning, training, prevention, research and development, and spill response.

Today, I will share some of my observations from the November 2007 *M/V Cosco Busan* oil spill in the San Francisco Bay. I will also emphasize some of the gaps in oil spill response technologies that remain. I will highlight some of the effective oil spill technologies utilized by OSPR that were developed as a result of the enactment of State and federal oil spill legislation.

M/V Cosco Busan Oil Spill

On the morning of November 7, 2007, the *M/V Cosco Busan* was at berth 56, at the Port of Oakland located on the Oakland Estuary. The *Cosco Busan,* a 900-foot container ship, departed with visibility estimated at less than one-fourth nautical mile. The *Cosco Busan* allided with one of the towers of the San Francisco Bay Bridge, resulting in the breach of three port wing tanks, spilling 53,000 gallons of bunker fuel into the San Francisco Bay. For almost three weeks, I served as California's incident commander. My role in this response gave me a unique perspective on the use and availability of oil spill technology.

The spill response by Federal, State, local government and private contractors was immediate and aggressive. Within 90 minutes of the incident, the oil spill response organizations had the on-scene recovery capability of 1.5 million gallons. The total on-water recovery capability on scene within six hours was more than 2.4 million gallons. However, effective deployment of assets was hampered by the very fog that contributed to the accident. The first helicopter overflight was not conducted until more than five hours after the allision.

Oil recovery and cleanup operations in and around the San Francisco Bay continued for months following the accident. Recovery rates of oil well exceeded industry norms. Forty three percent of the oil spilled into the bay was recovered.

By comparison, on July 23, 2008, a collision between a barge and tanker resulted in 250,000 gallons of fuel oil discharged into the Mississippi River near downtown New Orleans. This spill resulted in the closure of river traffic and disruption of commerce for weeks. Less than 12 percent of the fuel oil was recovered.

While the response to the *Cosco Busan* oil spill was a success, improvements in current technologies could have increased recovery of oil and the protection of the environment.

Examples of Technology Needing Improvement

Oil Detection During Reduced Visibility or Nighttime Conditions

One of the highest priorities during an oil spill is to contain and remove the oil from the water as early as possible. However, oil recovery is hampered during times of reduced visibility. As demonstrated during the *Cosco Busan* response, fog hindered accurate trajectory analysis and on-water recovery. Skimming operations were shut down at night because there was no mechanism for detecting the oil. While thermal imaging is an effective oil detection tool, fog limits the use of this technology. We lack a critical tool to detect concentrations of oil during periods of restricted visibility.

Containment in High Velocity Environments

Conventional containment and exclusion booms begin to fail when currents exceed three-fourths knots This limitation makes spill containment and protection of environmentally sensitive areas difficult if not impossible. We need a deployable boom that operates effectively in complex, high-velocity currents that are frequently encountered in coastal environments.

Chemical Dispersants

Chemical dispersants break oil into smaller particles that move into the water column. Currently, chemical dispersants are applied as a sprayed mix of water and dispersant onto freshly spilled oil. The type of oil, degree of weathering, sea state and other environmental conditions into which chemical dispersants can be applied safely and effectively, are limited. New delivery systems for dispersant applications including gels or other encapsulating forms show promise. However more research and testing are needed.

Ship Simulators

Ship simulators show tremendous potential in preventing maritime accidents. Just as airline pilots use simulators, they can be used by ship pilots and vessel masters to practice entering and navigating different California harbors and responding to different shipboard emergencies, such as loss of power or loss of steering. However, development of future simulators requires funding and programmatic support to improve and strengthen maritime navigational safety.

Examples of Emerging Technology Utilized by OSPR

Multi-spectral and Thermal Imaging

One of the most important initial steps in response to an oil spill at sea is the assessment of the extent of the oil slick and the quantity (i.e., thickness) and distribution of oil within it. Since most oils rapidly spread to very thin layers when released at sea, accurate determination of which areas contain the most amount of oil is vital for efficiently guiding oil spill response efforts. This emerging technology uses a combination of sensors to capture imagery from wavelengths outside of the human visible light range.

Platform A, located in federal waters six miles off of the Santa Barbara coast developed a leak in an oil tank in December 2007. We successfully utilized multi-spectral and thermal imaging technology developed by OSPR, MMS and a Southern California company to locate and characterize the slick. The Platform A oil spill response was OSPR's first operational use of remote sensing technology to confirm the presence of oil on the ocean's surface, accurately map the extent of the oil slick, classify the remote sensing images into oil thickness categories and present these data on a mapping web site for use by the incident command in close to real time.

This imaging system has enabled rapid oil spill mapping with far greater quantitative and geographical accuracy than is possible using only visual observations. Current planned refinements include improving the speed with which data can be captured, processed and disseminated.

High Frequency Radar Surface Current Monitoring

Along the California coastline, high frequency radar stations record ocean currents. OSPR funded research with San Francisco State University and the Naval Postgraduate School that allows the dissemination of the data via the Internet in Geographic Information Systems (GIS) format. These data, collected as part of a national framework called the Integrated Ocean Observing System, are used to create oil trajectories, implement strategies to protect sensitive habitats and position oil recovery assets where they would be most effective. Surface current data were used extensively during the *Cosco Busan* response to create trajectories using real-time conditions. These trajectories aided in the identification and protection of environmentally sensitive sites at risk.

Physical Oceanographic Real Time System (PORTS)

PORTS consists of a complex array of measuring instruments, cable, radio and telephone telemetry that compiles real time water levels, tide, current, salinity, and meteorological data for the channels, harbors and bays. It is an asset to safe navigation, spill response, search and rescue operations, and in the collection of historical data for determining long-term trends. The PORTS information is used on a daily basis by vessel operators, harbor pilots, educational institutions and recreational boaters.

In the years since its inception in California in 1995, the system has enhanced navigational safety for the full range of commercial, passenger and recreational vessels, improved pollution response and supported both environmental protection and commerce in California. PORTS is a cooperative effort by the State of California, harbor authorities and NOAA. Under Gov. Schwarzenegger's leadership, OSPR has been able to fully fund PORTS in the San Francisco Bay.

However, the use of PORTS in California has not reached its full potential. Due to limited funding,some harbors and commercial ports on the west coast lack access to the PORTS system. In addition, there is no mechanism to incorporate data from other systems, like the high frequency radar, into PORTS. Without a consistent funding effort for maintenance and upgrade improvements, PORTS will remain an effective but inconsistent tool for mariners. Currently, I am not aware of any new or upcoming technology that may be available to replace the PORTS system.

Geographic Information Systems

Geographic Information Systems (GIS) are fully integrated into oil spill prevention and response in California. GIS has proven to be an excellent data management and organizational tool for drills, exercises, contingency planning, natural resource damage assessment, response and recovery. We generate large amounts of data during an oil spill, much with a geospatial component. The inherent ability to import and display convergent data layers provides the incident commanders with powerful decision-making tools. GIS products are routinely used to track the progress of the response, guide daily activities and support the incident investigation.

California's Role in Federal Research and Development

OSPR's in-house research program has successfully partnered with federal agencies on several projects, as described earlier. For example, a proposal evaluated in OSPR's Scientific Study and Evaluation Program led to real world testing of multispectral and thermal imaging systems by the MMS at their Ohmsett facility in New Jersey.

In addition, OSPR co-sponsors a highly successful biannual technology workshop that focuses on federal, State, academic and private research efforts.

California has had limited but productive collaborations with the federal research program. My staff has served on National Academy of Science's panels evaluating chemical dispersants, the development of national research priorities in conjunction with the National Oceanographic and Atmospheric Administration's collaboration with the University of New Hampshire and the initial federal efforts for standardization of dispersant testing protocols. We would support a continued and increased role with respect to identification of research priorities and the practical application of new methods and technologies.

Conclusion

OSPR and the State of California recognize the need for continued improvement in the prevention of and response to oil spills. OSPR is committed to utilizing the best achievable technologies as required by statute to provide for the best achievable protection of the marine environment. We support federal research efforts to improve and develop technologies that address these issues.

Again, I would like to thank you for the opportunity to address this sub-committee. I would be happy to respond to any questions you may have.

BIOGRAPHY FOR STEPHEN L. EDINGER

Stephen Edinger is Administrator for the California Department of Fish and Game, Office of Spill Prevention and Response. A graduate of the University of California, Davis, Mr. Edinger was appointed as Administrator by Governor Arnold Schwarzenegger in November, 2008.

Stephen Edinger has spent his professional career protecting California's wildlife and natural environments, serving over 28 years in environmental law enforcement. He began his career in 1982 as a law enforcement ranger with the National Park Service. He then spent eight years as a ranger with the California State Park System along the northern California coast. For the past 17 years, he has served in various capacities with the California Department of Fish and Game. Mr. Edinger has investigated or served as the incident commander on hundreds of pollution events across California. He served as California's incident commander during the *M/V Cosco Busan* oil spill response in November, 2007.

Today Mr. Edinger oversees more than 200 employees dedicated to protecting California's habitats and wildlife from the devastating effects of pollution. He leads the Office of Spill Prevention and Response, which is recognized as the premiere spill response program in the Nation.

DISCUSSION

Chairman BAIRD. Thank you, Mr. Edinger.

At this point I will recognize myself for five minutes.

We have been joined, by the way, by Mr. Davis and Ms. Edwards. Thank you both for joining us.

ACHIEVING NECESSARY RESEARCH AND DEVELOPMENT MEASURES

You know, one of the things that tends to happen to all of us, I suppose, is that when there is a big crisis, a massive spill, *Exxon Valdez,* we scramble jets, create legislation, we all respond, and then there is a natural sort of decline in focus maybe.

I want to address that a little bit. Mr. Helton, you talked in your testimony a little bit, at least in the written testimony, about—that the comprehensive research, this is a quote, "Comprehensive research and development envisioned by OPA has not been fully achieved." What needs to happen to make that happen, to make the vision a reality?

Mr. HELTON. I would say that the agencies are working together to try to fulfill that vision. Resources are a limitation. There is—that is a consideration. I think that the plans are there. It just needs to be implemented.

Chairman BAIRD. Following up on that, OPA 90 created a coordinating committee on oil pollution research. What is the status of that committee? Does it meet regularly? Does it produce documents? Does it analyze effectiveness? What is the status of that?

Admiral WATSON. Yes, sir. It does meet. It works primarily through an ongoing amount of activity at conferences. There is research activity going on at the various laboratories, and the—I think that there is a constant communication between the various scientists, and then every two years there is a report that is compiled and submitted to Congress of all of the different activities. And these are categorized in the various different areas that help oil spill responders. In some cases it is the surveillance equipment, other cases it is the recovery equipment, the modeling oil in the water, the fate analysis of different types of oil over time in the water column, and so on.

So I think one of the main intents of that was to make sure there is not duplication of effort and to make sure that there is dialogue, and I think those two things are happening. Can that committee be taken to another level? I think it could be. I think actually if you look backwards in time, you will see that one time it was involved with grants to states and universities, for example. It spent a lot more money out of the Oil Spill Liability Trust Fund for research and development. Some of those things are a function of appropriations. Some of it was sort of an ending of the authority, for example, for the grants and the Oil Spill Liability Trust Fund expenditures.

Chairman BAIRD. That trust fund predominantly is designed—it is my understanding and feel free to correct me if I am wrong, to help fund the cleanup operation. Does it also fund the research side of it?

Admiral WATSON. Yes, sir. It has in the past. I think—I don't know the big number of all of the dollars spent on research out of the fund. I do know since its inception the fund has provided approximately $51 million to the Coast Guard's R&D Program, and that is how we develop things like the vessel of opportunity's skimming system and the skimming system that we have built into our buoy tenders so that they are ready at any time for an oil spill, and all sorts of different things. The pump that was used on the new Carissa to get the very viscous oil out of that hall while it lay on the beach there in Oregon, I believe. And so——

Chairman BAIRD. Right off our coast actually.

Admiral WATSON. Yes, sir. So these were some of the outcomes of R&D, and I am sure a lot of that was due to the fund.

Chairman BAIRD. But there may be a need to revisit that issue of whether or not that fund is still adequately contributing to ongoing research, apparently for a timed function and there is—it at least seems to be a bit of a question mark about whether or not a sufficient portion of that fund is actually going to fund the research. Is that a fair portrayal?

Dr. Venosa.

Dr. VENOSA. Yes. I think it is. I think the resources—I don't want to sound like a scientist who is begging for money, but I think that——

Chairman BAIRD. That never happens before this committee.

Dr. VENOSA. No, no. We never do that, but the resources—my budget has been about a half a million dollars for the—per year for the last 20 years. We have got, as I said, we have got a lot of publications out of it, but half a million dollars doesn't go very far.

And, in fact, a lab study that 20, 15 years ago cost 60 to $80,000 now costs 130. So really the budget has actually gone down.

Chairman BAIRD. Yes. I guess——

Dr. VENOSA. Due to inflation.

Chairman BAIRD.—I want to close out with really two questions and maybe we may pursue them later if we have another round.

One is the degree to which folks like Admiral Watson, Mr. Edinger, who are out there on the ground, more likely in the water I should say, trying to clean up the spills. You have each given some examples, and there is mention by Mr. Helton about dealing with cold water situations.

But one of my fundamental questions would be to what extent and through what mechanisms does the real world practitioner who says, gosh, if only we had a way to see where the darn oil is in the fog or at night or to suck up viscous material or to deal with cold water, to what extent does that drive the research? Where is that nexus? That is one question.

And then related to that is let us suppose you do drive the research, where is the financial incentive? This strikes me as a little bit like the problem we have with funding for pharmaceuticals to deal with rare disease outbreaks. All the incentives are in the wrong direction. Why should a drug company invest a significant amount of money for something that may never get to be used? If they do use it, they could get sued, et cetera.

And separately I worked on that issue, but here where is the incentive? Let us suppose Mr. Edinger says, "Look. I have got to get something that helps me identify where oil is at night." Where is the financial incentive for some company to invest in producing the products that allow you to do that? It is similar, I suppose, to the need for a more viscous pump. But that would be a second question. We don't have time to deal with it in this round, but I hope maybe we can get to that.

I will recognize Mr. Inglis for five minutes at this point.

POSSIBLE IMPROVEMENTS TO EXISTING MECHANISMS

Mr. INGLIS. Thank you, Mr. Chairman.

The Chairman was just asking the question about the *Oil Pollution Act of 1990,* and the Interagency Coordinating Committee. I wonder if anybody wants to comment on how it could be improved. I assume things are always subject to improvement, and if we approach it in a process way and say, you know, what could be really better about what was called for in that Act and driving things along.

Any thoughts about what you would like to see if you had a wish list of things that you could ask Congress and Congress would do it? What would that be?

Mr. HELTON. Well, we have a number of areas that we believe would be fruitful for research. I think the question is not necessarily the structure of the organizational committee as much as what resources that they have to take under—take new research, especially the areas I mentioned. There is a lot of new technologies that are available that we are not applying towards oil spills, we are not using some of the remote sensing, we are not using some of the unmanned aerial vehicles, things like that that are out there in industry now in other areas. Some of those areas need more research on how they can applied.

On the question of the nexus on research and how we make sure that research is appropriate, that the people in the field actually get their ideas to the scientists, the structure of the research that NOAA has done with the University of New Hampshire is actually intentionally designed that way. Every research project has an assigned field responder who is—who has expertise in that area from a field perspective to make sure that the research is providing information that is useful to the responders.

Mr. INGLIS. Anyone else want to comment on that?

Dr. VENOSA. EPA gets its research ideas so to speak from interactions with the program office, the Office of Emergency Management, because they deal with the on-scene coordinators on a daily basis, and they know what the—where the needs for inland oil spills are. And so I have an almost daily discussion with the OEM folks about research and what can we do to solve the problems that the on-scene coordinators are facing within our agency. And that is basically where we get our ideas for research, through interactions with the program office and the on-scene coordinators.

The Admiral talked about the Interagency Coordinating Committee, and I would like to say that I think it has worked—in fact, one of the ways that we do interact, and he didn't mention is through the Science and Technology Committee, which is a committee of the National Response Team. And the people who are—compose the International or the Interagency Coordinating Committee are also on that Science and Technology Committee. We meet on a monthly basis through conference call. We talk, always talk about the research that we are doing.

So we do communicate, we do collaborate, and we do coordinate. Perhaps we haven't been as good about reporting to Congress as much as we should, but at least we do do what we are supposed to be doing in terms of the directive.

Admiral WATSON. I would like to echo Dr. Venosa. I think that the system is working pretty good as far as having an ear toward the responder. I mean, the—both the Coast Guard and the EPA are the responders, and we are certainly very involved with that interagency committee and feeding those needs directly to the research facilities and the researchers.

I think one thing that—and you touched on it, Chairman Baird, you know, maybe coming up with some better incentives for companies for the private sector to be involved. Now, we try to stay involved and actually I am very complimentary about a number of privately-funded research activities, but that is a little less organized. It is not maybe as robust as it could be or as—led as well as it might be by the federal agencies on this committee.

There is also the international efforts, and, again, we try to be as involved as possible. The United States is seen as the world leader, and maybe this committee could have even a better leadership role if it was a little emphasis there.

Mr. EDINGER. Ranking Member, regarding participation by State, local entities, you know, certainly we want to continue to participate in this process. In California we don't necessarily do the research, but we apply the research that is done or funded by the Federal Government. So research certainly is very important to us.

As far as financial incentive, I think we could look once again to the *Cosco Busan,* which as Representative Woolsey said, may be not that large of a size of a spill but certainly significant in the response. Response costs are going to end up somewhere between 1,000 and $2,000 per gallon for a product spilled. So there is a financial incentive out there.

In addition, in California we have a regulatory structure that requires best achievable technology by the industry. The industry is required to use what is the best achievable technology, similar to what the Federal Government does. We are—have a work group together that includes Federal Government, includes State, includes non-governmental organizations looking at the different technologies and deciding which is the best achievable technology.

But there is a financial incentive certainly for companies to develop new technologies and for the industry to use those during an event.

Mr. INGLIS. Thank you. Thank you, Mr. Chairman.

Chairman BAIRD. Thank you. Mr. Luján.

INLAND SPILLS

Mr. LUJÁN. Mr. Chairman, thank you very much. Dr. Venosa, if I could begin with something that you said in your opening remarks about some of the concerns that you did have with support that may be needed to also address inland spills, I know that the overlying reason that we are here is some of the concerns that have occurred on our coast, but you brought up a point there that cause my interest. And if you could talk about that a little bit more.

And then to hear from each of you to your experiences or how maybe Mr. Helton or Admiral Watson or Mr. Edinger with your experience in California responsibilities both coastal and inland, on what can be learned from there so that way we are making sure that we are looking at the entire country for preparedness here.

Dr. VENOSA. Thank you. Yeah. I think in the area of inland spills, and this is my opinion, but I think and I said that we are probably going to have more spills rather than fewer as we change our emphasis in the future to biofuels development. I think you are going to—since all these biofuels are going to be transported by pipeline, and they are going to be stored in above-ground storage tanks, I think you are going to see that those pipelines do corrode, and so do the above-ground storage tanks. You are going to see more and more of these spills as we increase the volume production of biofuels in the future.

And so I think we need to start conducting research to try to—how do we deal with those new spills? I mean, these are new things to us. We have been doing research for 10 years on vegetable oils. We know a lot about vegetable oils and how they persist in the environment and how they are treated biologically, but we don't know enough yet. We have—and with biofuels they are slightly different from the vegetable oil feedstocks. We have—we don't know that much about them at all yet. Nor do we know anything about animal fats.

I think you are going to see a lot more of those being produced as well as being spilled.

Mr. HELTON. Thank you, Mr. Luján. My agency's primary focus is ocean and coastal resources, but we do support inland spills and work in the Great Lakes as well. We have all the inland rivers we provide support on. This is the—next week is the 10th anniversary of the Olympic Pipeline spill in Washington State, which is one of the spills I worked on that was 250,000 gallons of gasoline that was spilled into a coastal stream and caught fire and caused several fatalities as well as destroying a city park.

And so NOAA is involved in those level incidents as well and certainly it is something we try to remind our audience that we are not just talking about the large tanker accidents, that these can happen at any community, and we need to be prepared.

Admiral WATSON. One of the things I would like to mention is that the Coast Guard's National Strike Force is actually a national strike force that serves both the EPA federal on-scene coordinators as well as the Coast Guard federal on-scene coordinators who are responsible for the coastal spills.

So one of the things that happens almost without thinking is that all of the experiences and lessons learned from that team are shared throughout the country. They are deployed from three different locations, and they work for both EPA and Coast Guard, so you have got some real synergies going back and forth, even though EPA's focus is inland and normally fresh water.

There are, like you presumed, lessons learned. We do have some pipeline, some refineries, some chemical facilities in the coastal area that maybe are at lower numbers in terms of, you know, their numbers in the coastal zone, but when they have an incident, it quite often is a big incident, and we are glad to bring that knowledge and experience from the responses that our strike team has had working for EPA coordinators inland.

Mr. EDINGER. My office has responsibility, not just in the marine environment, but also the inland environment in California. We respond to petroleum oil spills in the inland environment. I could say without hesitation that we have more oil spills in the inland environment than we do in the marine environment. One of the differences normally is the marine environment is an open system, maybe much more difficult to corral than it is in the inland environment, but this year quantities and numbers of spills are much greater in the inland environment.

As I addressed in the opening statement, you know, booming systems for rapid, high-velocity areas like inland areas, rivers and streams, you know, having things that are easily deployable is something I think we still need some work and research on that, certainly some of the research that is being looked at in updating would help to address, I hope.

Mr. LUJÁN. I would like to know if there is something that we may be able to explore, understanding that there may be many more inland incidents but truly understanding when we talk about devastation when it comes to quantities how that may impact our oceans as well. Not to say that there is not devastation from one of these accidents occurring inland. We need to make sure as well that we are looking at this. As we lean from a technological perspective with arming our Coast Guard or first responders with the resources they need to adequately respond, we need to look to some of our laboratories with some of their expertise as well in being able to not only model these situations but in some of their homeland preparedness techniques, which may lend to some support in the specific area.

Thank you very much, Mr. Chairman, and thank you, Ms. Woolsey, for bringing this forward.

Chairman BAIRD. Excellent point, Mr. Luján. It was, indeed, 10 years ago that we had the terrible accident up in Bellingham. My colleague, Rick Larson, led the effort to fix that, and I will never forget the testimony of the families who lost children in that extraordinary explosion. Hundreds of thousands of gallons of gasoline ignited in one moment, and it devastated the community and killed three innocent people.

And so it is a very, very good point that this is not just a marine thing that happens offshore.

Ms. Woolsey.

CONTAINMENT BOOMS AND UNIVERSITY–AGENCY COOPERATION

Ms. WOOLSEY. Thank you, Mr. Chairman, and H.R. 2693 is not just a marine bill. It is an oil spill bill, in both prevention and cleanup.

Mr. Edinger, thank you for being a boots on the ground example to us. I mean, you are the great expert that we need to hear from because you were really right there. And you mentioned that the failure of containment booms when the currents exceed that certain speed, I think it is three-fourths of a knot, that this makes it really difficult and particularly for protecting environmentally-sensitive areas.

So knowing that and knowing that we need to do something about that, how do you go about and who do you give your feedback to. How does the process begin for you to get somebody to invent something that will work better?

Mr. EDINGER. Well, once again, Representative Woolsey, I would like to thank you for inviting me here and as a former resident of your District, I do appreciate all that you do.

Ms. WOOLSEY. It is a nice District, isn't it?

Mr. EDINGER. It is a great District. It is a great District.

As far as—there are incentives out there for the market environment. Regarding what we do now in protecting areas where we don't have the right tools we develop plans to use what is existing, what is out there right now. As an example, the *Cosco Busan,* we had difficulty with the Bolinas Lagoon, which I believe is in your district.

Ms. WOOLSEY. It certainly is.

Mr. EDINGER. The Bolinas Lagoon is a high-energy area. You have waves coming in, you have currents going up to five, sometimes six knots. We ended up having two very complex booming systems to try and keep oil out of that environment, but ultimately, that is very difficult. It is very difficult when you have limited resources as far as response capabilities, and quite frankly, often those technologies fail. There is a failure.

As far as who it is that we try and get to create these new systems, you know, unfortunately, we deal with what is in place. There is not a mechanism certainly for us to go out and say, you, here is a grant from the State of California to develop that. Really we rely on the Federal Government and some of the research that goes on with the agencies. Also with the Minerals Management Service.

Ms. WOOLSEY. Uh-huh. Well, thank you. Because you are the four agents including Mineral Management Services that my bill will be focusing on. What it does it is streamlines from 17 agencies to the four of you to ensure that we don't have this so dissipated that we don't get anything done.

But you said that you had conference calls, Dr. Venosa. Do you have all 17 agencies on those conference calls, or is it the doers that are right here at the table?

Dr. VENOSA. It is mostly the doers. I mean, we have, gee whiz, probably half a dozen to eight people who call in every month and talk about the research that we are doing. So——

Ms. WOOLSEY. Uh-huh.

Dr. VENOSA.—it is certainly not all 14 or 16 agencies that are named in the bill.

Ms. WOOLSEY. How do you get in touch with the universities, I mean, that we can apply for these grants in my bill to do the research and build the booms we designed? Somebody, I guess it would be a mechanical engineering group or something designing the booms we need. Who is talking to who? That is what I am trying to get to right here.

Dr. VENOSA. Well, we do—the agencies do talk to each other. We do. I mean, like we say every month, NOAA does it a little bit differently from the way we do it. NOAA has their CRRC, and they have their annual peer review request for proposals.

Ms. WOOLSEY. Uh-huh.

Dr. VENOSA. We also have—we have a competitive contract that we have in Cincinnati with the university——

Ms. WOOLSEY. Uh-huh.

Dr. VENOSA.—and we do a lot of research with that university both in house, among our own people, with people from the university who help us, as well as extramurally with that university.

Ms. WOOLSEY. And you are funding that project at the university?

Dr. VENOSA. Yes. Our—the monies that EPA gets, we funnel——

Ms. WOOLSEY. Uh-huh.

Dr. VENOSA.—we compete some of it.

Ms. WOOLSEY. Uh-huh. Uh-huh.

Dr. VENOSA. We—some of it goes to our LOE contract with that university, the University of Cincinnati, and some of it we do ourselves in house. We have in-house capabilities in not only our lab but other labs throughout the country.

Ms. WOOLSEY. And how do you get feedback on whether or not these programs are working once they are out in the field?

Dr. VENOSA. Well, everything that we do is peer reviewed——

Ms. WOOLSEY. Uh-huh.

Dr. VENOSA.—you know, and we all attend the same conferences. The oil spill community, research community is very small. We all know each other, and we get, we meet on a monthly basis, and we get together annually at various conferences. We know what is going on. We all know——

Ms. WOOLSEY. So then how come we didn't have booms that would work in anything beyond three-fourths knots? I mean, that is pretty still waters, isn't it, up until there?

Admiral WATSON. Well, there are booms that have been developed by research and developments for fast water, and there is also manuals that have been developed to give to the responders, and the—I guess the challenge is to having the right resources at the right place at the right time. And I don't know the specific circumstances of where these things were for the *Cosco Busan* but, you know, the weather is something you can't predict. I guess there is an expectation for fog out there in the San Francisco Bay obviously, and there is obviously rivers with a lot of potential for oil spills where you would pre-stage booms that are designed specifically for fast water recoveries.

But sometimes you have a spill that occurs in low visibility that is in a place that usually has low visibility or in fast water that maybe you were expecting a different type of a spill. We have to continue to get the mostly private response organizations, the oil spill response organizations, to produce and acquire the technologies that the R&D community develops.

Ms. WOOLSEY. Okay. Thank you, Mr. Chairman.

Chairman BAIRD. Thank you, Ms. Woolsey.

Mr. Davis.

SPILL PREVENTION

Mr. DAVIS. I watched and observed the *Exxon Valdez* spill, others that we have had in our country and along our streams. Observed it one time, a small pond on a farm where domestic oil wells were being drilled and stored in a tank and the tank erupted to a leak, went into the actual holding pond, and for somehow it leaked down through the soil and got into some springs and the pond ultimately had to be dammed off with roping that you use and eventually burned.

So I am somewhat aware as I look at the past and observe the damage that oil spills have had. And one of—I think Dr. Venosa. Am I saying that right?

Dr. VENOSA. Venosa.

Mr. DAVIS. Venosa.

Dr. VENOSA. Yeah.

Mr. DAVIS. You have to forgive me. I am from Tennessee, from the mountains of Tennessee, I guess some folks would say, but I know you made a comment that as we engage more in alternative fuels, perhaps maybe the piping underground of ethanol, that we could perhaps see more corrosion.

I think that is a long way off to be honest with you. We have got to grow an awful lot of switchgrass to get that much to where it would demand us maybe 10 or 15 percent of the uses to start putting pipes in. So I think our efforts to control spills that we may have from oil is perhaps our biggest challenge.

If you were to compare the safety today of transporting oil, are we using more and more, eight billion barrels a year that we use in this country alone? If you were to compare the safety record that we have today, either the four of you or all the four of you, compared to what we had a decade ago and two decades or three decades ago, how would you compare the safety records today? Do you think that we have adequate, in-place rules and regulations that would take us to the level of almost perfection in safety?

Either one. What do we have to do to be sure we get to the point to where we have 100 percent certainty we don't have a spill?

Mr. HELTON. I would say that the review of the data on the recurrence of spills is—there has been great success since the passage of OPA 90 and the reduction of spills has been significant. The problem is that spills, there is still that chance of a spill happening. We haven't safeguarded the system completely, so we still have to have preparedness but overall the system is much—much less oil is being spilled today than was being spilled in pre-OPA period.

Dr. VENOSA. Nothing is 100 percent. We will never, ever be free of oil spills or any kind of chemical spills for that matter. I mean, we can have the best technology in the world, and we probably do right now, and with double-hulled vessels and all that kind of thing, but you are going to always have weather accidents that we can't—hurricanes, you know, the Murphy oil spill in Louisiana. That was caused by a level five hurricane.

I mean, there is not much you can do about things like that. We can try to do as—the best science that we can, and we are doing the best science that we can right now, and I think we have, as Doug said, we have come a long way in improving our capabilities of responding to spills, but we will never be 100 percent able to prevent them.

Mr. DAVIS. Anyone else?

Admiral WATSON. I would just like to comment because I have spent a large part of my career on the prevention side, which is the point of your question here, as opposed to the response side, and we have implemented regulations for double bottoms and electronic equipment to improve navigation. I mean, just on the ship construction side. I think we are to the point where accidents are typically caused by human factors, at least in ships' navigating. There is probably some more work that could be done as far as engineering on some of the shore facilities that Dr. Venosa mentioned.

But there is still work going on in that area. I can tell you particularly in the area of human factors and regulation of vessels. For example, the Congress has authorized the Coast Guard to have an inspection regime for towing vessels. Most of the 7,000 towing vessels in this country are currently un-inspected, and so we were provided the resources just in this fiscal year to begin building an inspection program, and we hope to have the proposed rules out for that inspection regime very soon.

And there are, you know, there is other types of un-inspected activities that I think we could address in the maritime, and yet I think we can look back with a great degree of satisfaction in where—how far we have come just in my career.

So it is never good to pat yourself on the back too much, but it is nice to take some credit.

Mr. EDINGER. I would like to echo what Admiral Watson said that we have come a long way. The number of spills along our coastline has gone down. The amount spilled has gone down, but I still think if we look at the *Cosco Busan* as an example, that was a vessel vision, and we could look at the investigation and confirm that the bridge did not move. There was—they collided with a fixed object, which means that we will always have the potential for accidents where there is humans involved.

As Dr. Venosa also mentioned, you know, weather involved, a large weather event will cause spills. So we will always have spills unfortunately. The best thing we can do, though, is be as prepared as possible with the best technologies available.

Mr. DAVIS. I asked the question for a reason. As you look at the huge increase in our imports, whether it be by land or from Canada or Mexico, a great percentage of our crude oil that is shipped into this country comes from this hemisphere, not as some folks would believe from the Middle East. It really comes from our hemisphere. But as you look at that large volume, I am impressed that we haven't had much, much greater spills than we have had, because not only are we importing 60 some percent of the crude oil that we consume, that 60 something percent is a huge number increase in barrels from the last 30 years of what we used to bring in.

So I applaud the efforts of those, of you that have been involved in safety of those, enforcement, and others and continue to do equal or better job.

Thanks for being here today.

Chairman BAIRD. Ms. Edwards.

SCIENTIFIC MODELING

Ms. EDWARDS. Thank you, Mr. Chairman, and thank you for all your testimony.

I just have one question, and I don't know a lot about this. I do recall visiting with my son on a vacation the site of the *Exxon Valdez* spill and several years after the spill and seeing the continued devastation, and so I am curious about it. I wonder, Mr. Helton, in your testimony you talked about the research gaps related to your ability to do effective modeling, and so I wonder if you could explore that with us just a little bit more and particularly with respect to being able to simulate or use intelligent design to simulate different materials and quantities and densities, weather conditions, all of the factors that you described in your testimony.

And then your ability also to look at modeling in terms of impacts on ecosystems and communities. And I think it would be helpful for us if you were able to explore with a little bit more depth about where those research gaps are and what it is that this committee could consider to really fill them.

Mr. HELTON. Thank you, Congresswoman Edwards. That is a very excellent question because we struggle with modeling questions all the time. There is a number of kinds of models that we use in oil spill response and restoration. The ones that come to mind immediately are the models that we use to predict how the oil will behave once it is spilled in the water. The oil is going to behave—move laterally with currents and winds. It is also going to move into the atmosphere through evaporation, and it will also move into the water through disollution and dispersion.

Most of the models that we have focus on the surface layer, how the oil will move. We have less rigorous models predicting how the oil will move once it is dissolved into the water column. So that is an area of research, and we are trying to fill those gaps now.

But there is a whole other suite of models that we use for biological effects, trying to figure out what is the effects on a salmon run or a shellfish population after it has been exposed to an oil spill. So those—we have models that will help us predict the severity of exposure, the longevity of that exposure, but it could be much more rigorous. We use them in a predictive model to help us understand how to respond and how to improve our responses, but we have a long way to go to be certain and confident in those.

And you mentioned the *Exxon Valdez* and the lingering oil question is still an issue 20 years later, and one of the questions is how well can we model the oil once it has been entrained in those shoreline sediments and then being remobilized by storms and biotic activities.

So that is an area of research. The models that we have to predict how oil moves on the sea surface are not well calibrated for arctic spills. Once you throw in the variable of having broken ice conditions or even complete ice cover, we have little confidence in how that oil will behave and move because of that—the barrier that the floating ice causes.

Ms. EDWARDS. Is that also true for modeling the rapid changes that we are seeing related to climate affect your ability to model what would happen with a spill, you know, as we are in the throes of experiencing climate change?

Mr. HELTON. The climate change variable is a whole other additional variable when you are—when we are trying to predict the effects of a biological impact on a resource. For example, take a salmon run in Alaska. It may be changing because of climate independent of a spill and then adding a spill event on top of that creates a whole other level of complexity that happens at very different timescales, because the spill is having effects on the days to months to years level, and the climate effects are, you know, years to decades level. So it is a very complicated additional scenario to consider.

Ms. EDWARDS. And are there questions that you are asking now say 20 years down the line from the *Exxon Valdez* spill that should be instructive in terms of predicting the long-term impacts of an oil spill?

Mr. HELTON. We try to learn from every spill that we go to, and the *Exxon Valdez* has been fairly well studied in the long run. Several NOAA laboratories, EPA has done long-term research, Exxon has done research on the recovery as well. There is still a lot of uncertainty and a lot of—lack of consensus about how long it will take for that residual oil to resolve itself and when the non-recovered resources will recover.

And back to your previous question about climate change, one of the areas that we are particularly looking at that question is with very long-lived resources. Imagine a coral reef that is affected by an oil spill. So then you have very sensitive resources that are very sensitive to both oil and climate, and we know that they are already in decline because of climate impacts. So those would obviously be areas where those kinds of very sensitive resources would be the focus of additional research.

Ms. EDWARDS. Thank you, Mr. Chairman, and I know we can't study everything, and so sometimes it helps to have kind of a priority list of those things that need to be put at the top. Thank you.

Chairman BAIRD. Thank you, Ms. Edwards.

I have just a few follow-up questions, then we may—then if Ms. Woolsey has any, we may finish with that.

FUNDING FOR REAL-WORLD TOOLS

Ms. Woolsey, I was looking again at the text of the bill, and I think it is an outstanding bill. As I heard Mr. Edinger and the others, I still am concerned about this gap of where funding comes from to develop the real-world materials needed to deal with different situations. It is rather shocking, really. I mean, if I look at the waterways I am familiar with, there is not many waterways that have less than one knot current. When you look at the Puget Sound, the narrows of the Puget Sound is nearly eight-knot current at times in high ebb, and most rivers are going to have easily one-knot current.

And so the reason I say that if one of our best available technologies in booming is not able to meet the most likely scenarios that it is maybe to encounter, one says why hasn't something better been done?

And Ms. Woolsey, I would suggest there might be some merit to including economic research in the list of topics, and economic research I would suggest is worth considering is this. My hunch is the way many companies deal with the risk of oil spill is through insurance, and they deal with it insurance, and they basically buy off the risk. But buying off the risk probably doesn't incentivize the creation of new technologies to actually reduce the impact of the risk.

I mean, somebody would be smart enough to do the calculus and say, what is the probability, it is low of an incident, what is the cost relative to the cost of insurance, et cetera, and then so where is the financial incentive? I am not saying you should impose some draconian penalty structure, but my guess would be that if that is, in fact, how risk is capitalized, you are not going to have incentive to actually create the new tools, because there is going to be R&D costs, manufacturing costs, a low probability of use, et cetera, et cetera.

And so you may want to look at just sort of a regulatory economic structure that actually may impede rather than enhance development of this.

Another thing that strikes me——

Ms. WOOLSEY. If the gentleman would yield.

Chairman BAIRD. Please. I would be happy to.

Ms. WOOLSEY. Then when we have a hearing, I mean, have a markup, we can add that in as——

Chairman BAIRD. If folks have some suggestions, I would sure welcome that, because my hunch is that is part of what is going on here. You know, if somebody said, gosh, I have got a great idea for a piece of equipment to contain or recover oil from oil spills, I would interested in the economics of whether it makes sense to produce that. Maybe it is there. I don't know, you know, and given that we are apparently better at reducing the frequency of them, that makes the economics somewhat paradoxically less beneficial.

RESEARCH EFFORTS AS PROPORTIONATE TO NEED

I am also struck by the chart I think provided with Admiral Watson's testimony. As I look at that chart the major spills in '05, and '06, you can't tell necessarily from '04, it is on page five, came actually from ground sources. We tend to think of *Exxon Valdez, Cosco,* and much of our discussion today has been focused on that, but if we look at—and maybe I am misinterpreting this, net volume by source in the given years, they came from—you look at the Hurricane Katrina damages. People often say, oh, there were no oil spills in Katrina. There was a heck of a lot of oil spilled related to Katrina, but as I read it, I may be wrong here, much of that came from damages to oil storage facilities and a barge that ran aground on a devastated, a wrecked platform. But the bulk of that graph is oil storage facilities. In '06, 1.6 million gallons from damaged refineries, storm water setting tank, again, during a several storm.

Now, so much of OPA 90 was focused on at-sea spills, maybe we ought to ask ourselves to what extent—following up on Ms. Edwards' observation—should our research focus be proportionate to the actual causes at least as observed in recent years?

Does anyone care to comment on that?

Admiral WATSON. Yes, sir, I will just comment briefly and then maybe Dr. Venosa, but, yeah. What you are seeing here is—are large storage tanks that are affected by large storms. I think, you know, one of the, I mean, obviously huge amounts of oil is lost in one of these incidents, but there are berms around these facilities and I mean, there are regulations for this situation that mitigate even worse damage to the environment and——

Chairman BAIRD. Unless a flood overtakes the berm.

Admiral WATSON. Well, and that has happened. Yes, sir. So, you know, it is a tough problem. Do you invest a huge amount of money to make a storage tank hurricane proof——

Chairman BAIRD. If you build it in a hurricane zone.

Admiral WATSON. Right. Maybe that is what you have to do. Or do you do—you invest more in the berming system and the consequence management side. So——

OIL SPILLS AND CORAL REEFS

Chairman BAIRD. Yes. I just think we want to look at that, and that relates also to Mr. Luján's earlier question about, you know, non-maritime-related events.

As my colleagues know, I am very passionate about what is happening to our oceans and corals especially. It is my understanding that if, for example, you were to use dispersants, you could actually kill the coral, that the dispersants kill the coral. And so there is a generic question of are we spending enough attention on issues of coral-type environments and impact of spills and the remediation of spills.

And also to what extent is this worldwide, is this knowledge and technology disseminated worldwide? If you look at the coral triangle and for example. Do we know what we are doing when we are dealing with spills in the coral reef areas, and to what extent does the rest of the world know and have the technology to deal with that?

Mr. HELTON. Well, the subject of coral and oil spills could be a whole hearing in itself. It is something that NOAA has paid a lot of attention to, and we have a coral reef conservation program. One of the things that that program helped fund was research that was oil spill response guidelines for coral environments, and we would be happy to provide a copy of that manual to the Committee.

It is a very complicated issue. We know that dispersants can sometimes cause more harm than good, and evaluating what those tradeoffs are is a major part of the research that we have been trying to move forward on.

The idea of sharing that technology, the coral guide book that we prepared on oil spills was supposedly translated into Spanish to be available for the Caribbean region.[1] I am not aware of it being shared beyond that, but it is certainly available for that kind of use. [See *Appendix: Additional Material for the Record* for a letter from Noel Turner concerning a clarification to this statement.]

Chairman BAIRD. Thank you. One final comment I will make and then recognize Mr. Inglis, if he has comments.

My understanding is the Coast Guard spent about $20 million over the past 10 years on oil spill R&D. EPA spent 720,000 last year, I believe, and NOAA doesn't really have a line for this. Is that a correct understanding?

Mr. HELTON. That is correct. NOAA doesn't get a direct appropriation for oil spill R&D. We use base funds. Unlike some of the other agencies we don't have a line from the Oil Spill Liability Trust Fund. And as a point, I think the Interagency Coordinating Committee is a coordinator of research, but the Committee itself doesn't control any funds, any research priorities that they identify are then the responsibility of the individual agencies that have that authority and funding to move forward.

Chairman BAIRD. Reminds me of the lesson I was taught as a little child. You clean up your mess but in this case nobody is paying for the broom.

Mr. Inglis.

USEFUL SPIN-OFF TECHNOLOGIES

Mr. INGLIS. I wonder if there have been any spin-off technologies here from the work that we have been doing into other kinds of applications, so, you know, for example, drilling for geothermal resources resulted in better drilling techniques for the oil industry. I wonder—do you know of any spin-offs that have occurred here where other applications have been found from the technology that we are trying to develop to control oil and water?

Mr. HELTON. I think that the—we have borrowed technologies from other industries. I am not aware of any other industries borrowing our technologies. Is that the question?

Mr. INGLIS. Yeah. That was the question. I got to tell you what the Chairman said. Better salad dressing could be part of what comes out of this, you know. Keeping things mixed, I guess, that oil and water mixture.

Mr. HELTON. I was just passed a note that the medical community uses some of the sorbent technology. So——

Mr. INGLIS. Interesting. Yes. How about—one other thing for the Admiral. Do you own or have control over unmanned vehicles, reconnaissance vehicles, or if you needed one, where would you go to get it? You know, everybody always wants their own, of course, and maybe you have your own, but if you don't have your own, can you go get them somewhere else?

Admiral WATSON. Yes, sir. We, of course, are a member of the Armed Services, so we are working very closely with the Air Force and the Northern Command for Homeland Security, and then we are very involved with the project that the border, Customs and

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[1] The coral guide book on oil spills has not been translated into Spanish. OR&R has translated four of its publications into Spanish, including: "Open Water Oil Identification Job Aide for Aerial Observation," "Shoreline Assessment Job Aide," "Trajectory Analysis Handbook," and "Characteristic Coastal Habitats: Choosing Spill Response Alternative."

Border Protection have. They owned a predator, and they have been testing those for the border, and we are working on a marinize, which means for the maritime environment, a version of that. So I don't know exactly where this R&D acquisition plan is going to end up, but my guess is that there will be a cross use of these assets.

And, you know, just almost going back to your last question, I can't answer exactly how oil spill stuff has been used elsewhere, but I can tell you that a lot of the tools that we have developed for the various Coast Guard missions, whether it is search and rescue or whether it is Homeland Security or whether it is fisheries patrols, oftentimes are handy in an oil spill event as well. Some of the surveillance equipment, you mentioned unmanned aerial surveillance vehicles. These are things that will be able to carry any sort of sensor equipment that can fit in there, and when we develop these things, we will—as we have for the last two decades, equip them to be able to be used in an oil spill or a chemical incident as well.

Mr. INGLIS. That is helpful, because, you know, I am aware of a municipality that wanted basically an armored personnel carrier, and they got it from Homeland Security, a Homeland Security grant. I was asking them, well, why don't we just call up the National Guard that has those assets. Can't ever reach them was the answer, and I said, well, maybe we could buy them a cell phone and then you could have two cell phones, two red cell phones, and if you ever need one of those armored personnel carriers in this city in South Carolina, perhaps we could use the red phones to call rather than having a multi-million dollar piece of equipment now that we have paid for. So we have got two within two miles of each other.

You know, so I hope that when we do this sort of thing with the, you know, figuring out how to track this oil, that we really can move assets seamlessly from the Air Force to the Coast Guard to get them assigned to a spill quickly. A bunch of red cell phones might be a good idea, you know, so we can make sure that we can get those.

But really, it is—that is something that seriously look into is quickly deploying those assets so that we don't have, you know, this situation of waiting for the drone to come over and find where it is going because we can't get the asset there. It could become a very frustrating and damaging situation.

So it sounds like good protocol to work on. What do you think? Making sure it can be deployed quickly.

Thank you, Mr. Chairman.

Chairman BAIRD. Ms. Woolsey, we have about 11 minutes, 50 seconds until the vote, so you are recognized.

Ms. WOOLSEY. Right, and we know that it is going to be about 25 minutes before that vote is over.

Chairman BAIRD. No. Remember, we changed that policy.

Ms. WOOLSEY. Oh, no, no, but we didn't. All right.

THE RESOURCE OF VOLUNTEER AID

Mr. Helton, you mentioned in your testimony about depending on how well local communities engage, and I believe engage in the cleanup and the response and all of that.

I can tell you that during the *Cosco Busan* cleanup, my constituents were really frustrated. We had armies of volunteers that wanted to be down there on the beach cleaning up, cleaning the fowl that were coming in, you know, and trying to save their lives and all that. They were turned back because they weren't trained. So first of all, I need you to tell me what you meant by how well the communities engage.

But there is something in my legislation that says extramural grants and it includes detecting or mitigating oil discharges. By helping volunteers, keeping them prepared and trained, would that be helpful in the mitigation of these disasters? Do you see it as that, or what did you mean by that?

Mr. HELTON. I had a very broad statement about engagement of local communities before, during, and after spills that would include the example that you raised of volunteers. What I was thinking of when I was drafting the testimony was the broader experiences from large spills like the *Exxon Valdez,* where some communities after the spill suffered very substantial social disruption from the influx of the response as well as the damage, the loss of their fisheries, loss of income.

So especially in rural subsistence communities a spill can have very significant impacts to their economy and social structure, and a city like San Francisco, I don't think that it had that kind of impact, but it certainly had a social impact and essentially a double tragedy because people felt strongly about trying to prevent the spill and clean up the spill and then being denied the ability to help out. They were essentially injured twice.

And so—and I am sure your office received thousands of calls from citizens about that.

Ms. WOOLSEY. Yes, indeed.

Mr. HELTON. There is an effort through the National Response Committee to address how volunteers can be better used. There are a number of concerns about management of a cadre of volunteers that might change on a daily basis so we don't want to take away resources from the response to train 1,000 people one day and then have a different 1,000 people the next day that have to be trained.

But that is a major focus of the NRT Committee this year and perhaps the Coast Guard could address that.

Ms. WOOLSEY. Okay. Admiral Watson.

Admiral WATSON. That is a function of an oil spill response quite often, is that you need to have some capacity to provide training, and as Mr. Helton said, it is particularly an issue when you have people whose subsistence depend on the water that has been affected. That has been something I have been involved with personally up in northern Washington coast where the Macaw Indian Tribe was affected by a significant oil spill, and the National Response Team is working on that issue. I think that was one of the lessons learned from the *Cosco Busan* spill, and it is going to have to be something that is really implemented at the local level.

Ms. WOOLSEY. Right.

Admiral WATSON. But the guidelines and the targets for what we want to achieve in the long run will be established by the—at the national level by the National Response Team.

Ms. WOOLSEY. Right. Thank you for reminding me. The fishermen were out there in their boats. I mean, they would have done anything to help and realize they didn't have permission and didn't quite know what they were supposed to do.

Mr. Edinger.

Mr. EDINGER. You brought up a great point about the *Cosco Busan.* The need for volunteers, you know, never before have we had volunteers that wanted to actually go up and clean oil up on California's beaches. We have seen people that will swim through oil to save wildlife, but we have never seen people that are willing to go out and actually clean up oil themselves.

So we changed things. With the U.S. Coast Guard we have changed the Area Contingency Plan in the San Francisco Bay to address that, but kind of overarching also was the problem we had on the *Cosco Busan* was never getting in front of the story. The public was looking at that. It was Veterans' Day weekend. They were looking at the oil on the beaches, and they never really understood what was going on with the beaches. We never got in front of the story to say, you know, our efforts right now are on the water efforts, to get the water—the oil off of the water as soon as possible, and the sandy beaches where the oil was being deposited, that is actually a place where we could deal with it much better than anywhere else.

So we were going through a progression in our spill response, but we never got that message out. We have developed tools, websites, use social media to get the message out for the next spill. We have also worked with the local volunteer centers to make sure that we have a mechanism in place to engage them should one of these events occur in the future.

Ms. WOOLSEY. I believe that the people in that area would be willing to be certified, take training, even though they don't expect there ever to be another spill, just in case, so they would be prepared before the spill.

Thank you, Mr. Chairman. Thank you very much for this hearing.

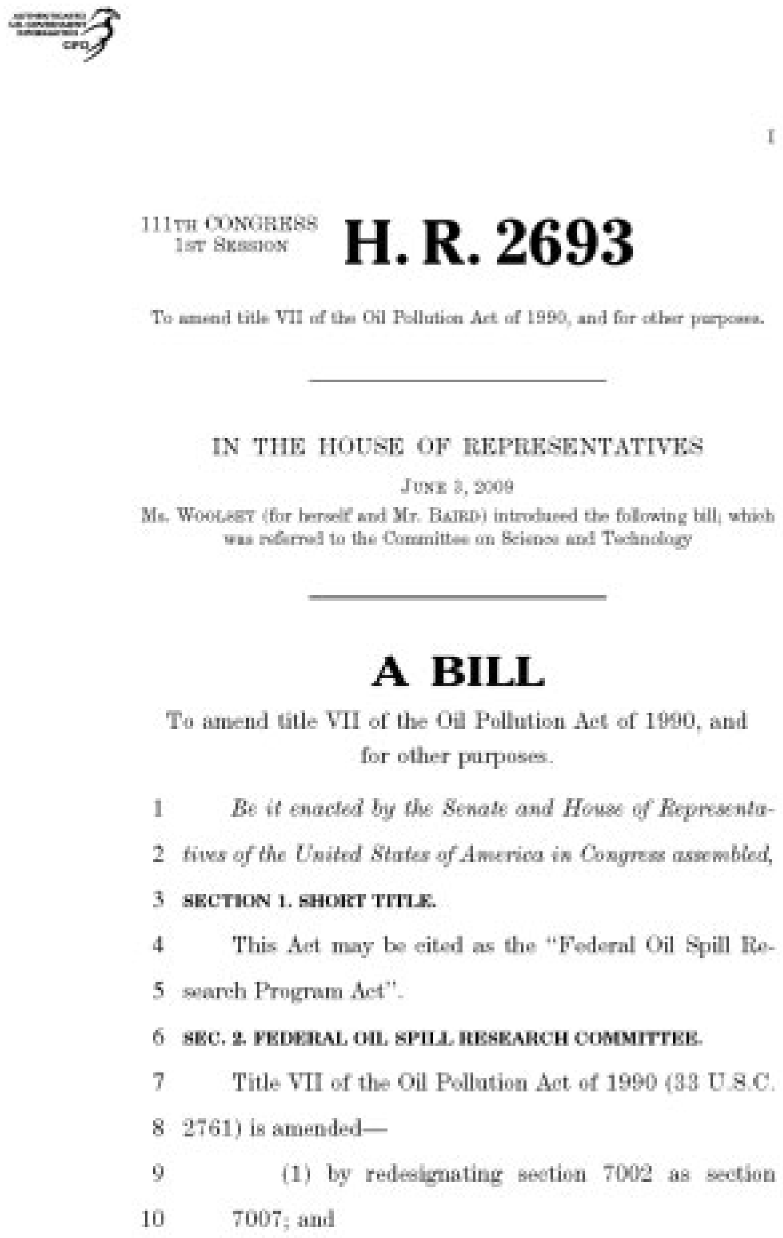
Chairman BAIRD. Thank you, Ms. Woolsey, for introducing the legislation, and thanks to our witnesses and all the others who have participated today. I thank my colleague, Mr. Inglis, for his insightful questions, and with that the hearing stands adjourned. Thank you very much. Enjoy the day.

It is customary to hold the record open for two weeks to allow for additional statements from Members and for answers to all the follow-up questions that the Committee may have asked the witnesses.

[Whereupon, at 3:38 p.m., the Subcommittee was adjourned.]

Appendix:

ADDITIONAL MATERIAL FOR THE RECORD



I

111TH CONGRESS
1ST SESSION

H. R. 2693

To amend title VII of the Oil Pollution Act of 1990, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

JUNE 3, 2009

Ms. WOOLSEY (for herself and Mr. BAIRD) introduced the following bill; which was referred to the Committee on Science and Technology

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A BILL

To amend title VII of the Oil Pollution Act of 1990, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Federal Oil Spill Research Program Act".

SEC. 2. FEDERAL OIL SPILL RESEARCH COMMITTEE.

Title VII of the Oil Pollution Act of 1990 (33 U.S.C. 2761) is amended—

(1) by redesignating section 7002 as section 7007; and

(2) by amending section 7001 to read as follows:

"SEC. 7001. FEDERAL OIL SPILL RESEARCH COMMITTEE.

"(a) ESTABLISHMENT.—

"(1) IN GENERAL.—The President shall establish an interagency committee to be known as the Federal oil spill research committee (in this title referred to as the 'Committee').

"(2) CHAIR.—The President shall designate a representative of the National Oceanic and Atmospheric Administration to serve as chairperson.

"(b) COMPOSITION.—The members of the Committee shall include representatives from the National Oceanic and Atmospheric Administration, the United States Coast Guard, the Environmental Protection Agency, and such other Federal agencies as the President may designate.

"(c) FUNCTION OF THE COMMITTEE.—The Committee shall—

"(1) coordinate a comprehensive Federal oil spill research program (in this title referred to as the 'program') in accordance with section 7002 to coordinate oil pollution research, technology development, and demonstration among the Federal agencies, in cooperation and coordination with industry, institutions of higher education, research institutions, State and tribal governments, and other relevant stakeholders;

"(2) complete a research assessment (in this title referred to as the 'assessment') on the status of the oil spill prevention and response capabilities in accordance with section 7003; and

"(3) develop a Federal oil spill research plan (in this title referred to as the 'plan') in accordance with section 7004.".

SEC. 3. FEDERAL OIL SPILL RESEARCH PROGRAM.

Title VII of such Act (33 U.S.C. 2761) is further amended by inserting after section 7001 (as amended by section 2 of this Act) the following new section:

"SEC. 7002. FEDERAL OIL SPILL RESEARCH PROGRAM.

"(a) IN GENERAL.—The Committee shall establish a program for conducting oil pollution research, development, and demonstration.

"(b) PROGRAM ELEMENTS.—The program established under subsection (a) shall provide for research, development, and demonstration technologies, practices, and procedures that provide for effective and direct response to prevent, detect, recover, or mitigate oil discharges and include—

"(1) new technologies to detect accidental or intentional overboard oil discharges;

"(2) transport and fate of oil, including trajectory and behavior predictions due to location, weather patterns, hydrographic data, and water conditions;

"(3) response capabilities, such as improved booms, oil skimmers, and storage capacity;

"(4) research and training, in coordination with the National Response Team, to improve the removal of oil discharge quickly and effectively;

"(5) decision support systems for contingency planning and response; and

"(6) improvement of options for oily/oiled waste dispersal.".

SEC. 4. FEDERAL RESEARCH ASSESSMENT.

Title VII of such Act (33 U.S.C. 2761) is further amended by inserting after section 7002 (as added by section 3 of this Act) the following new section:

"SEC. 7003. FEDERAL RESEARCH ASSESSMENT.

"Not later than 1 year after the date of enactment of this section, the Committee shall submit to Congress an assessment of the status of oil spill prevention and response capabilities that—

"(1) identifies research programs conducted and technologies developed by governments, institutions of higher education, and industry;

"(2) assesses the status of knowledge on oil pollution prevention, response, and mitigation technologies;

"(3) identifies regional oil pollution research needs and priorities for a coordinated program of research at the regional level developed in consultation with State, local, and tribal governments;

"(4) assesses the status of spill response equipment and determines areas in need of improvement, including amount, age, quality, effectiveness, or necessary technological improvements;

"(5) assesses the status of real-time data available to mariners, researchers, and responders, including weather, hydrographic data, and water conditions, and the impact of incomplete and inaccessible data on preventing, detecting, or mitigating oil discharges; and

"(6) is subject to a 90-day public comment period and shall address suggestions received and incorporate public input received, as appropriate.".

SEC. 5. FEDERAL RESEARCH INTERAGENCY PLAN.

Title VII of such Act (33 U.S.C. 2761) is further amended by inserting after section 7003 (as added by section 4 of this Act) the following new section:

"SEC. 7004. FEDERAL RESEARCH INTERAGENCY PLAN.

"(a) IN GENERAL.—

"(1) PLAN.—Not later than 1 year after the submission of the assessment required under section 7003, the Committee shall submit to Congress the plan that shall establish the priorities for Federal oil spill research and development.

"(2) RECOMMENDATIONS.—In the development of the plan, the Committee shall consider and utilize recommendations by the National Academy of Sciences and information from State, local, and tribal governments.

"(b) PLAN REQUIREMENTS.—The plan shall—

"(1) suggest changes to the program to improve the rates of oil recovery and spill mitigation;

"(2) make recommendations to improve technologies, practices, and procedures to provide for effective and direct response to oil spills;

"(3) make recommendations to improve the quality of real-time data available to mariners, researchers, and responders; and

"(4) be subject to a 90-day public comment period and address suggestions received and incorporate public input received, as appropriate.".

SEC. 6. EXTRAMURAL GRANTS.

Title VII of such Act (33 U.S.C. 2761) is further amended by inserting after section 7004 (as added by section 5 of this Act) the following new section:

"SEC. 7005. EXTRAMURAL GRANTS.

"In the execution of the program, the Secretary of Commerce, acting through the Administrator of the National Oceanic and Atmospheric Administration, shall—

"(1) award competitive grants to institutions of higher education or other research institutions to carry out projects to advance research and development and to demonstrate technologies for preventing, detecting, or mitigating oil discharges that are relevant to the goals and priorities of the plan; and

"(2) incorporate a competitive, merit-based process for awarding grants that may be conducted jointly with other participating agencies.".

SEC. 7. ANNUAL REPORT.

Title VII of such Act (33 U.S.C. 2761) is further amended by inserting after section 7005 (as added by section 6 of this Act) the following new section:

"SEC. 7006. ANNUAL REPORT.

"Concurrent with the annual submission of the President's budget to Congress, the Committee shall submit an annual report to Congress that describes the activities and results of the program during the previous fiscal year and outlines the objectives for the next fiscal year.''.

SEC. 8. NATIONAL ACADEMY OF SCIENCE PARTICIPATION.

The Secretary of Commerce, acting through the Administrator of the National Oceanic and Atmospheric Administration, shall contract with the National Academy of Sciences to—

(1) assess and evaluate, not later than 1 year after the date of enactment of this Act, the status of Federal oil spill research and development as of the day before the date of enactment of this Act;

(2) submit a report to the Federal oil spill research committee established under section 7001(a)(1) of the Oil Pollution Act of 1990 and to Congress evaluating the conclusions and recommendations from the Federal research assessment under section 7003 of such Act to be utilized in the creation of the Federal oil spill research plan under section 7004 of such Act; and

(3) submit a report to Congress, not later than 1 year after the Federal oil spill research committee's submission of such plan, evaluating the plan required by section 7004 of such Act.

SEC. 9. TECHNICAL AND CONFORMING CHANGES.

(a) Use of Funds.—Section 1012(a)(5) of the Oil Pollution Act of 1990 (33 U.S.C. 2712(a)(5)) is amended—

(1) in subparagraph (A), by adding "and" after the semicolon; and

(2) by striking subparagraph (C).

(b) National Academy.—Section 5001(c) of such Act (33 U.S.C. 2731(c)) is amended by striking paragraph (4).

(c) Table of Contents.—Section 2 of such Act is amended by striking the items in the table of contents related to sections 7001 and 7002 and inserting the following:

Sec. 7001. Federal oil spill research committee.
Sec. 7002. Federal oil spill research program.
Sec. 7003. Federal research assessment.
Sec. 7004. Federal research interagency plan.
Sec. 7005. Extramural grants.
Sec. 7006. Annual report.
Sec. 7007. Submerged oil program.

STATEMENT OF MINERALS MANAGEMENT SERVICE DEPARTMENT OF THE INTERIOR

JUNE 4, 2009

The Minerals Management Service (MMS) is the bureau within the Department of the Interior responsible for the management of the Nation's renewable energy, oil, natural gas, and other mineral resources on the Outer Continental Shelf (OCS) as well as the energy and mineral revenues from the OCS and from federal onshore and American Indian lands. From the gasoline that powers our cars, the natural gas that heats our homes, and the benefits obtained through the disbursement of collected mineral revenues, the Nation and its citizens benefit from the efforts of the MMS.

The MMS has jurisdiction over approximately 1.7 billion acres of the OCS, on which there are about 8,100 active oil and gas leases. We work with other federal agencies, State and local governments, industry, and academia to achieve a common objective to maintain high standards for safety and the environment and to meet national economic, security and energy policy goals. The OCS is a significant source of oil and natural gas for the Nation's energy supply, providing about 14 percent of domestic natural gas production and 27 percent of domestic oil production.

MMS recently published the final rule-making that provides the framework to grant leases, easements and rights of way for the orderly, safe, and environmentally responsible development of renewable energy resources on the OCS such as wind, wave, and ocean current.

The MMS has a robust regulatory system designed to prevent accidents and oil spills associated with OCS oil and gas exploration and production. However, whenever oil is being handled—whether in tankers, pipelines, or production facilities, whether onshore or offshore, and whether in the U.S. or abroad—spills are a possibility. For that reason it is imperative that U.S. and international agencies work together to prepare for oil spills in a comprehensive manner. This preparation includes continued improvement in response technology and procedures.

MMS is pleased to have the opportunity to present the Committee with information on the MMS Oil Spill Response Research Program and the operation of Ohmsett—The National Oil Spill Response Test Facility.

Overview

For more than 25 years, the Minerals Management Service (MMS) has maintained a comprehensive, long-term research program to improve oil spill response technologies. The major focus of the program is to improve the knowledge, technologies and methodologies used for the detection, containment and cleanup of oil spills that may occur on the OCS and disseminate findings through a variety of public forums such as workshops, conferences, peer-reviewed publications and the Internet. The intent is to make this information widely available to oil spill response personnel and organizations world wide. The activities undertaken by the MMS oil spill response research (OSRR) program comply with the research and development provisions of Title VII in the *Oil Pollution Act of 1990* (OPA 90).

The OSRR program provides research leadership to improve the capabilities for detecting and responding to an oil spill in the marine environment. In the past decade the OSRR program has been making progress in developing technological advances to improve the ability to clean up oil spills in Arctic environments. This includes development of systems, equipment and methodologies that can be used in extremely cold temperatures and in broken ice conditions. These advancements have allowed oil and gas exploration and development activities to move forward in Arctic offshore environments and will produce real cost savings.

The OSRR program is a cooperative effort bringing together funding and expertise from research partners in government agencies, industry, and the international community to collaborate on oil spill research and development (R&D) projects. The OSRR program operates through contracts with universities, government agencies and laboratories and private industry to assess safety-related technologies and to perform necessary applied research.

Funding for the OSRR program activities is appropriated from the Oil Spill Liability Trust Fund (OSLTF). MMS plans and implements OSRR projects that have multiple phases in a step-wise approach over several years, enabling the MMS to secure cooperative funding from private industry as well as countries that have offshore regulatory programs. The MMS OSRR program monitors and capitalizes on the efforts of other agencies and industry whenever possible through active partnering. More than 40 percent of the OSRR projects are Joint Industry Projects, where MMS partners with other stakeholders to maximize research dollars.

The MMS coordinates oil spill research closely with the National Oceanic and Atmospheric Administration (NOAA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA) through participation on the National Response Team and on the Interagency Coordination Committee for Oil Pollution Research. This allows the MMS to foster collaborative research at the national and international level, optimize current and future research initiatives, minimize research duplication, and ensure that MMS's interests are addressed. Partnering has reinforced the MMS's oil spill response research and development and encouraged oil spill technology development efforts by academia and industry. The MMS has participated in the exchange of technological information with Canada, France, Germany, Japan, Norway and the United Kingdom through cooperative research projects, workshops and technical meetings.

Information derived from the OSRR program is directly integrated into MMS's offshore operations and is used to make regulatory decisions pertaining to permitting and approving plans, safety and pollution inspections, enforcement actions, and training requirements. The MMS as well as US and foreign government agencies and organizations worldwide utilize the results from the OSRR program and Ohmsett in making planning, regulatory, and emergency response decisions. Current OSRR projects cover a wide spectrum of oil spill response issues and include laboratory, meso-scale and full-scale field experiments.

Major topic areas include:

- — Remote sensing and detection of spilled oil
- — Physical and chemical properties of crude oil
- — Mechanical containment and recovery
- — Chemical treating agents and dispersants
- — *In situ* burning

MMS Oil Spill Response Research

Success from the MMS OSRR program comes from a step-wise research approach to solve specific research needs that includes formation of joint industry projects to expand the scope and leverage program funds. Many significant technical advances in oil spill response can be attributed to successful multi-phase research projects that involve scientists worldwide. Applied research and the development of response strategies traditionally involve a combination of laboratory small-scale tests, meso-scale tank and basin experiments, and full-scale field trials. The MMS has used this approach to develop, initiate, and conduct more than 200 successful oil spill research projects.

Once the MMS has identified a research need or data gap in spill response we initiate and conduct a scoping project to define the current state-of-the-art for this technology or methodology. The results from these scoping projects are used to develop a systematic approach required to successfully address the data need. Communicating the results from these projects to government agencies and private industry is the next step to build consensus on the future research direction. A carefully focused work plan or agenda encompassing a priority list of projects is developed. It is generally beyond the capabilities of any one organization to fund these projects in their entirety. International cooperation, including governmental and industry participants, is needed to make substantial progress in the most important research and development areas. Given the specialized nature and limited number of researchers actively working on oil spill response, it is essential to involve different centers of expertise on a global scale. The MMS has initiated many successful joint industry projects (national or international) to leverage our program funds and expand the scope of the project to develop innovative or new technological advancements to detect, contain, and cleanup oil spills in the marine environment.

Ohmsett—The National Oil Spill Response Test Facility

The passage of the *Oil Pollution Act of 1990* (OPA 90) significantly expanded MMS's role in oil spill research. Title VII of OPA 90 mandated the reactivation of Ohmsett—The National Oil Spill Response Test Facility located in Leonardo, NJ. The Interagency Coordinating Committee on Oil Pollution Research (created by OPA 90) delegated this responsibility to the MMS. Ohmsett is the only facility in the world where full-sized oil spill response equipment can be tested and training of first responders can be conducted with a variety of oils in a simulated marine environment under controlled conditions. The primary feature of Ohmsett is a large outdoor, above ground concrete test tank which measures 667 feet long (the approximate length of two football fields) by 65 feet wide, by 11 feet deep. It is filled with 2.6 million gallons of crystal clear salt water. Ohmsett is also the premier training site for spill response personnel from State and Federal Government agencies, private industry and foreign countries. This includes the U.S. Coast Guard Strike Team personnel. MMS now manages Ohmsett as part of its mandated requirements to ensure that the best and safest technologies are used in offshore oil and gas operations. On July 22, 2009, Ohmsett celebrated its 17th anniversary under MMS management and to date 24 countries have made use of the facility.

The facility provides an environmentally safe place to conduct objective, independent testing of oil spill response equipment as well as training responders. Many of today's commercially available oil spill cleanup products and services have been tested at Ohmsett either as off-the-shelf commercially available equipment, or as equipment or technology still under development. In North America, a large portion of existing independent performance data and information on containment booms and skimmers has been obtained through testing at Ohmsett. The MMS has expanded the capabilities of Ohmsett to test all types of oil spill response equipment and techniques. The testing capabilities of Ohmsett were recently upgraded to provide a simulated Arctic environment for cold water testing and training. This capability will allow Ohmsett to remain operational year round, offering testing, training and research. We now have the ability to test and evaluate fire resistant containment booms using an air-injected propane burner system that realistically simulates in situ burning at sea. We have added the capability to conduct effectiveness testing on a variety of chemical treating agents, dispersants, emulsion breakers, and sorbent products.

The use of chemical dispersants is another important option in oil spill response. The Ohmsett facility is a world leader in realistic dispersant effectiveness testing through the design and development of a calibrated, referenced and realistic test protocol and subsequent testing under cold and temperate conditions using fresh and weathered crude and fuel oils. The National Research Council strongly supported the use of wave tank testing in their recent review of chemical dispersants. Ohmsett is the world's largest wave-tank complex presently conducting such research, and is the logical venue for bridging the gap between laboratory and field testing.

The Ohmsett facility is developing the capability to conduct independent and objective performance testing of emerging marine renewable energy devices. The objective is to provide as realistic conditions in the model scale as possible including realistic parameters for wave heights, wave periods, and directional spreading water depth. The program includes the development of standard test protocols both nationally and internationally.

Ohmsett is an integral part of the MMS oil spill research program and is essential for fulfilling the agency's regulatory responsibilities under OPA 90. The facility directly supports MMS's mission of ensuring safe and environmentally sound oil and gas development on the OCS. Ohmsett is not only an important component of the MMS oil spill research, it is also a national asset where government agencies, private industry and academia can conduct full-scale oil spill research and development programs in a controlled environment with real oil. Ohmsett allows research, testing and evaluation of equipment, systems and methodologies, and responder training to take place in a controlled environment.

Significant Accomplishments of the MMS Oil Spill Response Research Program

Following are some examples of the significant accomplishments of the MMS OSRR Program and how these new technological advances are currently being operationally used worldwide to respond to oil spills in the marine environment.

1. Detection of Oil In, On, and Under Ice

The ability to detect reliably and map oil trapped in, under, on, or among ice is critical to mounting an effective response in Arctic waters. In the past, the only successful method for detecting the presence of oil in or under ice involved drilling holes through the ice sheet or by sending divers down under the ice to delineate the extent of a spill. This method is expensive, labor intensive, and exposes personnel to the vagaries of extreme weather.

In 1999, the MMS initiated a project to evaluate potential remote sensing techniques to detect oil trapped within and under ice. Of the many technologies recently reviewed, only ground penetrating radar (GPR) showed potential. Between 2003 and 2008 the MMS initiated four international joint industry projects to develop GPR into a functional remote monitoring sensor. Two of these projects conducted offshore Svalbard, Norway involved a permitted, intentional oil release for research purposes.

2. Oil Spill Thickness Sensor

One of the most important initial steps in response to an oil spill at sea is the assessment of the extent of the oil slick and the quantity (i.e., thickness) distribution of oil within it.

A critical gap in spill response is the lack of capability to measure and map accurately the thickness of oil on water and to rapidly send this information to response personnel in the command post.

In testimony given before the Subcommittee, Mr. Doug Helton of NOAA, cited the need for remote sensing technologies during the *Cosco Busan* oil spill to detect oil effectively, determine areas of the thickest amounts of oil, and then use this information to direct skimming operations to increase the recovery of spilled oil.

In November 2005, the MMS initiated a research project that would enable the measurement of oil slick thicknesses using multi-spectral aerial imagery. The California Department of Fish and Game, Oil Spill Prevention and Response (DFG/OSPR) partnered with MMS on this project and provided technical expertise with the Geographic Information System component of this project. Over a three-year period (2005–2008) the aerial mapping system was developed through a systematic approach which included many overflights of the Coal Oil Point, CA natural oil seeps. In November 2007, remote aerial sensing of the *Cosco Busan* oil spill was performed using the prototype thickness sensor mounted to a small plane and flown over the spill area to test the system under actual field conditions. The sensor performed as expected and could effectively identify the extent and high density areas of the spill. Under commercial application this aerial thickness sensor could have been used to prioritize clean-up activities. The full system integration flight of the aerial thickness mapping system was successfully completed in November 2008.

On December 7, 2008, there was an oil spill from Platform A in the Santa Barbara channel due to a ruptured tank. The California Department of Fish and Game, Oil Spill Prevention and Response used the aerial thickness mapping system to acquire image data. The data was immediately processed and made available to the Unified Command center for guiding response operations. The data was used to recover successfully the spilled oil over a five-day period and none of the oil hit the shoreline.

3. Mechanical Containment and Recovery in Arctic Ice Environments

More than a decade of MMS research has focused on methods to improve the effectiveness of equipment and techniques for the mechanical recovery of oil spills in ice-infested waters. This research has substantially improved mechanical recovery of oil spills in Arctic environments. In October 2004, the MMS initiated a research project with the University of California, Santa Barbara (UCSB) to study the process of oil adhesion to the surface of oil skimmers and to identify parameters to improve their efficiency. Over a three year period (2004–2007), numerous laboratory, small and large scale tank tests were conducted to improve the mechanical recovery of oil. Research results demonstrated that changing the surface pattern of the drum will improve recovery efficiency by over 200 percent. The results from this research project were patented by UCSB and the principal investigator (PI). The PI was awarded her doctoral degree as a result of her research. There are at least six types of grooved skimmers being commercially sold around the world that resulted from this research.

4. In Situ Burn Research

MMS was designated as the lead agency for *in situ* burn research (ISB) in the Oil Pollution Research and Technology Plan prepared under the authority of Title VII of the OPA 90. The use of ISB as a spill response technique is not new, having been researched and employed in one form or another at a variety of oil spills since the 1960's. Burning as a response tool for oil spills in broken ice has been researched since the early 1980's using both tank tests and medium to large-sized experimental spills. Many scientists and responders believe this technique is among the best option for oil spill response in the Arctic, especially with a high degree of ice coverage. Between 1995 and 2003, the MMS partnered with the National Institute of Standards and Technology to conduct more than ten different ISB research projects.

To disseminate results of eight years of intensive ISB research, the MMS assembled a comprehensive compendium of scientific literature on the role of in situ burning as a response option for the control, removal and mitigation of marine oil spills. All operational aspects of burning are covered in detail. It contains more than 350 documents with over 13,000 pages and nearly one hour of video. The MMS has distributed more than 2,000 ISB–CD sets worldwide.

In situ burning is now considered a viable countermeasure for offshore oil spills. Regional Response Teams (RRT) and Area Committees are integrating the use of *in situ* burning into their response protocols and contingency plans. Overall the opportunity for use, growing inventory of equipment resources and the trend for Federal On-Scene Coordinators (FOSC's) and RRT's to seriously consider and more readily approve its use indicate an expanded role for *in situ* burning in the Arctic.

5. Dispersants in Cold Water/Broken Ice Environments

The use of chemical dispersants in is another important option in oil spill response.

The Ohmsett facility is rapidly becoming a world leader in realistic dispersant testing through the design and development of a calibrated, referenced and realistic test protocol and subsequent testing under cold and temperate conditions using a variety of crude and fuel oils. Ohmsett is the world's largest wave-tank complex presently conducting dispersant research and is a logical venue for bridging the gap between laboratory and field testing. The National Research Council strongly supported the use of wave tank testing in their recent review of chemical dispersants. In the past seven years there have been fourteen major dispersant research projects conducted at Ohmsett. Experiments at Ohmsett have demonstrated that dispersants are effective in near-freezing water temperatures but this is highly dependent on the properties of the crude oil. Dispersants can be effective in broken ice if there is some mixing energy present (wind, waves, movement of ice floes caused by wind, waves, and currents). Dispersants can potentially provide an invaluable third response option when strong winds and sea conditions make mechanical cleanup and in situ burn techniques unsafe and/or ineffective.

Results from dispersant testing at Ohmsett are being used by local, State and federal regional response teams and regulators to support the use of dispersants as an oil spill response tool in their jurisdictions. Results from dispersant testing in cold water/broken ice conditions at Ohmsett have been used by industry to gain regulatory approval for the use of this countermeasure for the Sakhalin Island project in Russia and for planned projects in the Canadian Beaufort Sea.

6. Chemical Herders

Spilled oil rapidly spreads on the waters' surface into very thin slicks. Chemical herders have the ability to quickly clear oil films from the waters' surface. The intention of herding is to thicken oil slicks sufficiently to allow them to be cleaned up with conventional mechanical containment systems or through the use of *in situ* burning or the use of dispersants.

Since 2004, the MMS and ExxonMobil have jointly funded research to evaluate using herders to extend the window of opportunity for oil spill response options in Arctic environments. Research efforts have focused on the use of herders to thicken oil slicks in broken ice to allow them to be effectively ignited and burned. Three years of laboratory, small and large scale tank tests were completed. In May 2008, two full scale burn experiments were successfully conducted during an intentional oil spill exercise offshore Svalbard, Norway. In February 2009, the MMS conducted research on the use of herders to improve the efficiency of mechanical containment and recovery systems. More than 400,000 pounds of ice was delivered to Ohmsett for these experiments. Research on the use of herders to expand the use of dispersants will be conducted at the Ohmsett facility in October 2009.

Oil Spill Response Research Outreach

The MMS collaborates with State, Federal and international governmental agencies, organizations, and private industry to coordinate oil spill response research and Ohmsett testing. We also participate in international, regional and local conferences, workshops and meetings to present the results of MMS funded OSRR projects. We publish and disseminate the results of OSRR projects as widely as possible in peer reviewed scientific papers and articles, in technical journals and reports and in public information documents. The MMS sponsors and participates in Arctic related oil spill response workshops and conferences to disseminate results from the OSRR program and from Ohmsett testing, training and research activities to the public. The MMS maintains a website that contains a listing of all Arctic OSRR projects funded by the MMS as well as downloadable reports and film clips free of charge.

The Ohmsett facility also plays an important role in environmental outreach by informing the oil spill community of oil spills, environmental contamination, cleanup methods and testing. Ohmsett's recently renovated conference room enables various federal, State, academic and private organizations to conduct on-site committee meetings and conferences. Facility tours and presentations are given upon request.

Regular attendance at both U.S. and international environmental conferences plays an important role in getting the information, the analysis and the results achieved from the research projects to the public.

Publication of *The Ohmsett Gazette,* the facility's semi-annual newsletter, keeps the oil spill community abreast of recently conducted facility activities. Ohmsett's website describes the testing that the facility conducts and gives objective results of the research conducted. Staff members also participate in environmental education projects such as school science fairs, college work study programs, and student mentorship programs. Through this type of public interaction, Ohmsett is able to increase public awareness by educating the community of the importance of marine safety and environmental protection.

The MMS Environmental Studies Program (ESP)

In addition to the Oil Spill Response Research, MMS also conducts the Environmental Studies Program which is designed to gather scientific information needed for stewardship of coastal and marine environments as we manage the development of OCS energy and minerals. A component of this broad-based program focuses on the collection and development of scientific information needed to understand and predict the fates and effects of potential oil spills from these OCS activities.

The MMS assesses oil-spill risks associated with offshore energy activities on the OCS by calculating spill trajectories and contact probabilities. These analyses address the likelihood of spill occurrences, the transport and fate of any spilled oil, and the environmental impacts that might occur as a result of the spill. The MMS Oil-Spill Risk Analysis (OSRA) Model combines the probability of spill occurrence with a statistical description of hypothetical oil-spill movement on the ocean surface. Paths of hypothetical oil spills are based on hind-casts (history) of winds, ocean currents, and ice in arctic waters, using the best available input of environmental information.

The research to support the oil-spill risk analyses includes scientific observations of the ocean surface circulation in the Gulf of Mexico, in the Santa Barbara Channel and Santa Maria Basin offshore Southern California, and in the Beaufort and Chukchi Seas off Alaska. In addition, MMS has sponsored development of ocean surface circulation models in these areas, as well as most recently in the mid-Atlantic OCS area, to provide input for OCS lease sale environmental analyses. As the oil and gas industry moved into deepwater areas of the Gulf of Mexico, we also undertook research to characterize the deepwater current movements in the Gulf of Mexico to assist our assessment of a possible release of oil from these ocean depths. In Alaska, we have sponsored research to better describe the weathering of oil on snow and ice, and we have sponsored field studies and modeling of sea ice—ocean movement and the interaction with spilled oil. The Environmental Studies Program research management philosophy always seeks out partners, and much of the research described is linked to programs in NOAA and NASA, as well as cooperative efforts with key universities in the affected States.

The MMS is committed to the continuous improvement of OSRA estimations and environmental impact statements (EIS) analyses, and uses the results of new observation and modeling to better manage OCS oil and gas development. As offshore activity expands into deeper waters and new geographic areas, MMS oil-spill modeling will be applied to pertinent risk assessments and validated with environmental observations.

Modeling results are used by MMS staff for preparation of environmental documents in accordance with the *National Environmental Policy Act;* other federal and State agencies for review of EISs, environmental assessments, and endangered species consultations; and oil industry specialists preparing the oil spill response plans.

Conclusion

Mr. Chairman, this concludes MMS's prepared statement. Thank you for the opportunity to present an overview of the MMS's oil spill response research program and the Ohmsett facility. The program directly supports the MMS mission of ensuring safe and sound operations on the OCS and has made substantive technological advances in the ability to detect, respond and cleanup oil spills in the marine environment. MMS would be happy to respond to any questions.

OIL POLLUTION RESEARCH
AND
TECHNOLOGY PLAN

INTERAGENCY COORDINATING COMMITEE

ON OIL POLLUTION RESEARCH

APRIL 1997

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Interagency Oil Pollution Research and Technology Plan

Executive Summary

Background

Title VII of the Oil Pollution Act of 1990 (OPA 90) established the thirteen member Interagency Coordinating Committee on Oil Pollution Research (Committee). The Committee is charged with coordinating a comprehensive program of research, technology development, and demonstration among federal agencies in cooperation with industry, universities, research institutions, state governments and other countries. This responsibility includes preparation of an Oil Pollution Research and Technology Plan, which the Committee prepared and submitted to Congress in April 1992. At the same time, the Committee also provided a copy of the plan to the Marine Board of the National Research Council (Marine Board) for review and comment as required by the OPA 90. Upon review, the Marine Board recommended the plan be revised using a framework that addresses spill prevention, human factors, and the field testing/demonstration of developed response technologies. This updated version of the plan incorporates these Marine Board recommendations.

Plan s Framework and Content

An analysis of the oil production and transportation system serves as the underlying framework for the plan which describes the system and identifies the strengths, weaknesses, and problems associated with the production and transportation of oil and its products. The plan then assesses current oil spill prevention, preparedness, and response technologies and identifies program areas where research and development (R&D) are needed to fulfill the intent of OPA 90. These needs are based on an analysis of activities that result in spills, the sources of spills, and the volumes of oil released at various points in the oil production and transportation system.

Research and Technology Priorities

The plan's analysis of the oil production and transportation system indicates clearly that the threat of oil spills remains real and substantial. By both source and volume, the waterborne transportation system poses the greatest risk of spills, with roughly half of the oil spilled in offshore and coastal U.S. waters coming from tankships and barges. However, inland production, transportation, and distribution also account for a substantial volume of spilled oil, with onshore pipelines becoming an ever increasing source of large oil spills. The positive side of the situation is that over 60 percent of all oil spills are preventable, since they result from equipment failure, operator errors, and deliberate dumping.

Much remains to be done in the broad categories of spill prevention; spill response planning, training, and management; spill countermeasures and cleanup; and fate (what happens to oil when it enters the environment), transport (how oil moves through the environment) and effects, monitoring and restoration. While R&D efforts should continue in each of these categories, spill prevention holds the most significant potential benefits and should be emphasized. However, since spill prevention will never eliminate all oil spills, spill response technology development and evaluation should continue at present levels.

Reduction of the risk of oil spills and their associated environmental and social costs requires that an active, coordinated, and well-funded R&D program be maintained. In pursuit of this goal, the Committee developed this plan to make the case for a continuing federal oil spill R&D program for the next 5-10 year period, and specifically designated the following technology areas as oil spill R&D priorities (Level 1 being highest).

Interagency Oil Pollution Research and Technology Plan

Level 1 Priority

- Prevention through understanding Human Factors related to spill accidents;
- Offshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention;
- Onshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention;
- Decision Support Systems for Contingency Planning and Response;
- Spill Trajectory and Behavior Prediction;
- Offshore countermeasures: Dispersants and *In situ* Burning;
- Improved technologies for Oil Spill Surveillance;
- Effects and effectiveness of Shoreline Countermeasures and Cleanup;
- Environmental Restoration Methods and Technologies; and
- Understanding Spill Impacts and Ecosystem Recovery.

Level 2 Priority

- Improved Navigation and Waterways Management;
- Advanced Vessel Design;
- Training and Readiness Evaluation simulators;
- Improving options for Oily/Oiled Waste Disposal;
- On-Water Containment and Recovery equipment; and
- Basic Fate and Transport of oil.

Level 3 Priority

- Response Personnel Health and Safety protocols;
- Alternative On-Water Countermeasures;
- At Source Containment and Countermeasures; and
- Vessel Damage Assessment and Salvage methods.

(Note: Underlined segment is the title of the technology area as it appears in Table 11 and Appendix A.)

Interagency Oil Pollution Research and Technology Plan

While pursuing R & D in these specific technology areas, there is a need to address several general issues, which will aid in achieving the desired advances in oil spill research and acting on the recommendations of the National Research Council's Marine Board. To carry out the program of field testing that the Marine Board determined to be a vital component of the federal plan, work must continue to develop streamlined permitting procedures and protocols for carrying out experimental oil spills in the environment and capitalizing on spills of opportunity. To bridge the gap from laboratory testing to full-scale field testing and use, mesoscale testing of spill response equipment is critical. The National Oil Spill Response Test Facility provides the research and response communities with unique capabilities in this regard and the Committee supports the facility's continued operation and maintenance by the Minerals Management Service (MMS).

Another recommendation of the Marine Board dealt with public perception of and participation in the decision-making process. One method of addressing this is to recognize the importance of universities and non-profit institutions in finding solutions to oil spill problems, and to encourage the creation of regional centers of expertise. Federal cooperation with various stakeholders should continue with the aim of leveraging both knowledge and resources.

Finally, a great deal of work remains to analyze and model the oil spill system. Success in this area would result in an improved understanding of events leading to oil spills and what actions can be taken to minimize their occurrence. Improving the quality of oil spill data available for building this model, conducting risk analyses, and developing pollution prevention policies, remain topics for continued interagency action.

Introduction

Public outcry over the rash of oils spills in 1989 and 1990, including the now notorious accidental grounding of the EXXON VALDEZ, culminated in the enactment of the Oil Pollution Act of 1990 (OPA 90). Title VII of OPA 90 established the Interagency Coordinating Committee on Oil Pollution Research and specified the membership, which consists of representatives from the Department of Commerce (including the National Oceanic and Atmospheric Administration (NOAA) and the National Institute of Standards and Technology (NIST)), the Department of Energy (DOE), the Department of the Interior (including the Minerals Management Service (MMS) and the U.S. Fish and Wildlife Service (since renamed the National Biological Service (NBS)), the Department of Transportation (including the U.S. Coast Guard (USCG), the Maritime Administration (MARAD), and the Research and Special Programs Administration (RSPA)), the Department of Defense (including the U.S. Army Corps of Engineers (USACE) and the U.S. Navy (USN)), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), and the U.S. Fire Administration (USFA) in the Federal Emergency Management Agency (FEMA). The Act mandated that the Committee, chaired by the Department of Transportation, coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the Federal agencies, in cooperation with industry, universities, research institutions, state governments, and other nations, as appropriate, and foster cost-effective research mechanisms, including the joint funding of research. It also required the preparation of an Oil Pollution Research and Technology Plan that would serve to coordinate all federal oil pollution research activities.

The first Oil Pollution Research and Technology Plan was submitted to the Congress on April 24, 1992. The original plan defined the role of each Federal agency involved in oil spill R&D and outlined the overall Federal approach to this R&D. It listed projects based on three possible levels of effort: (1) current (FY 1992) funding levels; (2) funding based on Congressional appropriation of the $27 million of R&D funds authorized by OPA 90 for each of the next five years; and (3) the funding required to fill all identified information and technology gaps. As required by OPA 90, the Committee contracted with the National Research Council (NRC) of the National Academy of Sciences for an assessment of the plan's adequacy. This review was conducted by the NRC's Committee on Oil Spill Research and Development under the auspices of the Marine Board, and was submitted to Congress in May 1993.

The NRC was appreciative of the efforts that went into developing the plan, specifically its inclusion of many important R&D topics and its formalizing of the communication network for addressing oil spill issues. However, it candidly found that "these features ... do not constitute a comprehensive structure for addressing the oil spill problem in a systematic manner," and noted that the document lacked the elements of a coherent and comprehensive plan. Their overarching recommendation called for an analysis of the oil spill system to identify its underlying problems and suggest solutions. This analysis would then lead to the development of an R&D strategy to achieve these solutions. While budget limitations restricted its efforts to develop a model of the oil spill system, the Committee used the recommended systems analysis approach to revise the plan.

For the federal agencies tasked with oil spill prevention and response, the historically cyclical nature of public attention and funding has recurred in the wake of the EXXON VALDEZ. When the first plan was submitted, it was presumed that the additional resources authorized by OPA 90 would be appropriated. As this did not occur, the plan was not implemented to a level much beyond existing agency programs. Consequently, most of the information and technology gaps of 1990 remain.

A similar loss of priority is evident in the private sector. The Marine Spill Response Corporation (MSRC), the oil industry supported oil spill response organization formed after the string of oil spills that resulted in the passage of OPA 90, funded approximately $30 million dollars of oil spill R&D through 1995. It terminated this program as of January 1, 1996. Meanwhile individual oil companies are funding only minimal oil spill R&D, with much of the work again being conducted through the American Petroleum Institute's (API) ongoing programs.

The Committee has enjoyed modest success through its efforts to improve communications among active members of the federal, state, and industry spill research and response community, and to leverage resources whenever possible. For instance, it is monitoring the activities of several states, including Alaska, California, Louisiana, Texas, and Washington as they conduct R&D activities of particular importance to their community needs. These activities are evaluated with an eye towards establishing partnerships, when feasible, and are likely to provide results with national, if not worldwide applications.

The Committee coordinates the R&D activities of member agencies, including the adaptation of Department of Defense technologies for use in the civilian sector. It oversaw the reopening of the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) at the National Oil Spill Response Test Facility in Leonardo, New Jersey, which is now under the management of MMS, and through aggressive marketing, is being used by national and international customers. In addition the Committee cosponsored two International R&D forums, bringing together researchers from around the world, and was instrumental in establishing a database of ongoing oil pollution R&D, which is available free of charge and maintained by the International Maritime Organization.

The Committee submits an updated plan structured on the recommendations of the NRC. This plan provides a general assessment of the status of information and technology on oil spill prevention, response, and cleanup, while identifying and prioritizing those areas requiring additional R&D to fill the gaps. It is hoped that by publicizing the federal priorities and actions, non-federal entities will see opportunities to work in partnership with the federal agencies and reduce the risk of oil pollution.

I. The Context of Oil Spill Research and Technology Programs

A. The Oil Production and Transportation System

In keeping with the "systems" approach, Figure 1 is provided to illustrate the major subsystems which make up the United States oil production and transportation system. It ranges from the time crude oil is taken from the ground or transported into United States waters until the finished product is delivered to bulk storage terminals.

As shown in Figure 1, for the purpose of planning R&D activities, the oil production and transportation system is defined in terms of five subsystems:

- **Origination of crude oil in the United States** - This includes onshore and offshore production facilities and crude oil tankers traveling in U.S. waters with crude oil from foreign sources.

- **Movement of crude oil to refineries** - This includes pipelines extending from onshore and offshore production facilities to refineries or intermediate transfer facilities, as well as the loading and unloading of crude oil carrying tank ships, barges, and tank trucks at refineries or intermediate transfer facilities.

- **Refining of crude oil into products** - This includes the storage of crude oil, actual refining operations, the storage of refined products, and the loading of refined products to vessels, barges, tank cars, or trucks.

- **Transport of refined products** - This includes the transportation of the refined products to the bulk distribution point by any mode of transportation. A growing amount of imported refined products enter the system at this point.

- **Storage of refined products** - This includes offloading operations at the bulk terminal, storage of the product, and loading of the product to the tank truck, barge, or other mode of transportation for shipment to the consumer. Retail operations such as local gasoline or home fuel oil sales are excluded.

It is important to recognize that potentially damaging discharges of crude oil or petroleum products can and do occur at every point in this system (the frequency and quantity of oil spills at each point in the system are presented later), and that the factors which can influence the occurrence of these accidental discharges includes: the design, construction, maintenance, and operation of vessels and facilities; personnel training, and human engineering concerns.

The design of an R&D program based on the probability of a spill occurring at any given location in the system would be enhanced by a mathematical model of the movement of oil in the United States and by better spill data. As this model remains in the early stages of development, it is necessary to base risk estimates on expert opinion and anecdotal information. These estimates, along with information on potential spill damage under various geographical and environmental conditions, form the basis for the R&D needs presented in this plan.

Figure 1: Oil Production and Transportation System

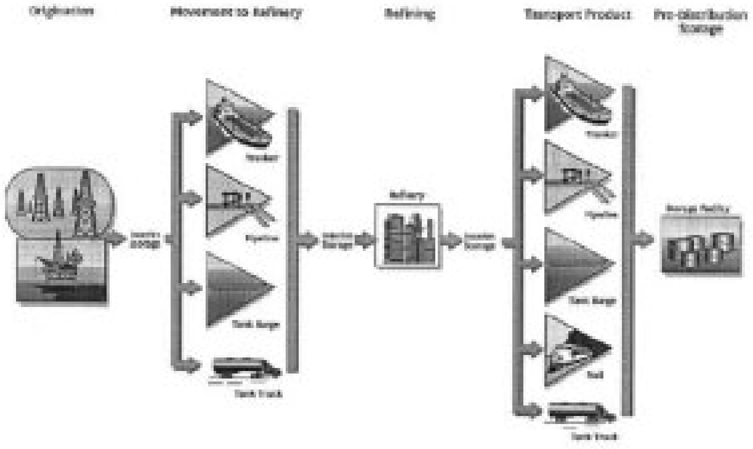

Figure 1 Oil Production and Transportation

B. Qualitative Assessment of Oil Production and Transportation System Spill Risks

If we view each mode of transport and facility type in the simplified schematic of the oil production and transportation system (Figure 1) as a possible oil spill source, we can find data to support claims that improved safety and operating procedures put in place over the last 10 years have generally reduced the risk of a spill at any point in the system. However, because accidental oil spills cannot be eliminated, efforts to improve pollution prevention and response must be continued. In this section, four high risk spill sources are examined to highlight existing weaknesses and concerns, and the efforts being made to address them.

Tank Ships and Tank Barges

The reduction of operational and accidental oil spillage in the U.S. over the past five years can be attributed partially to the stiff economic consequences facing spillers as a result of the liability provisions of OPA 90. The public's intolerance of oil spills has also led to the adoption of national regulations, most of which were mandated by OPA 90. These domestic regulations include requiring (1) new tankers to be equipped with double hulls to reduce accidental discharges of oil in the event of grounding or collision; (2) tankers to be escorted by tugs in environmentally sensitive ports; (3) tankers to carry spill cleanup equipment; (4) better training of vessel crews; (5) emergency oil transfer equipment for tankers; and (6) vessel emergency pollution response plans.

Led by the United States' position on oil pollution prevention and response, the international community, through the United Nations-sponsored International Maritime Organization (IMO), has supported meaningful changes of several international standards. These include Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), the International Convention for the Safety of Life at Sea (SOLAS), and the Standards for Training, Certification and Watchstanding (STCW). The amendments to SOLAS and STCW are noteworthy in that they look beyond the traditional equipment or engineering fixes to oil pollution by recognizing and addressing the significant role that the human element plays in marine casualties and oil spills. Changes include the creation of the International Safety Management Code in SOLAS, Chapter 9, which requires independent audits of the managerial practices of vessel operating companies. Enforcement of this code should help ensure that vessels engaged in oil transport are receiving the home office support necessary to complete a casualty free voyage. STCW changes are aimed at increasing the levels of training received by officers and crew, and providing more rest for watchstanders.

While these regulatory changes are significant and helped move the shipping community in the direction of prevention, the threat of a catastrophic oil spill in United States waters remains high and is arguably growing. The key risk factor associated with this claim is the ever-increasing volume of imported oil and refined product entering the country. This results in increased tank ship movements, the use of larger tank ships, and more inherently risky offshore lightering operations. The trends towards reduced crew complements and increased use of multinational crews, which often have language barriers and lack adequate training, also pose significant risks and must be addressed.

Offshore Exploration and Production Facilities

The relatively excellent spill record for domestic offshore drilling and production over the past 20 years suggests that technology and procedures for preventing oil spills are being employed effectively. In order to sustain this record, the offshore industry must continue R&D activities to meet the new challenges associated with deep water development, reduced staffing, and increased participation by smaller, and often less experienced operators.

For example, innovative subsea, floating, and tension leg facilities are being employed as production in deep water areas of the Gulf of Mexico increases. However, modifications in production safety systems are required to work in these areas and the effectiveness of deep water design and safety management practices remains to be demonstrated.

Also, many new operators are assuming responsibility for production from aging facilities in the shallower waters of the Gulf of Mexico, while major producers are operating facilities with fewer personnel and an increased reliance on contractors. These changes pose both management and operational challenges.

MMS is working with the offshore industry to evaluate these concerns. Current efforts involve joint deep-water work groups to evaluate development options and associated safety and environmental risks, industry-prepared operating plans addressing the application of new technology and procedures, and third-party review of facility design and installation proposals.

Additionally, many operators are developing Safety and Environmental Management Programs (SEMPs) which address the human and organizational factors critical to accident and spill prevention. MMS and the Department of Energy are assisting the smaller companies in developing these plans. The MMS Technology Assessment and Research Program is cooperating with industry on a series of workshops and studies to assist operators in assessing and mitigating operational risks.

Pipelines

While they typically do not receive the media attention given to major marine casualties, pipelines have historically been a primary source of oil spills both offshore and onshore. MMS records for 1984-1993 show that 98% of spills associated with Outer Continental Shelf (OCS) operations, which were greater than 50 barrels or 2100 gallons, resulted from pipeline operations. While the aging of the offshore pipeline network is of concern, corrosion and other age-related factors have not been a major cause of offshore spillage. In fact, virtually all of the major OCS pipeline spills have been caused by external damage from anchors and other vessel-related activities. Consequently, reducing OCS spills depends on a reduction in pipeline incidents.

Recent efforts to locate and accurately mark all OCS pipelines appear to be having their desired effect, as incidents involving external damage have declined in recent years. MMS is digitizing this location data for all OCS pipeline segments in order to provide readily available information on pipelines that could be affected by proposed offshore construction activities, and to assist in determining the source of any leaks. A similar program for pipelines in state waters could provide similar benefits.

As a result of OPA 90, the onshore oil pipeline system has received increased scrutiny. In contrast to the record of offshore pipelines, the cause of onshore pipeline accidents is split almost evenly between external damage and age-related factors. The Research and Special Program's Administration's Office of Pipeline Safety is engaged in collaborative R&D with industry which focuses research in those areas likely to reduce significantly the risk of pipeline accidents. These R&D programs include a national locating and mapping program similar to the MMS offshore effort; improving and integrating information systems to facilitate response and risk management activities; expanding the technology of non-destructive evaluation through research into automated inspection probes ("smart pigs"); and ongoing refinements in risk analysis and assessment to improve the agencies regulatory program.

Refining and Storage Facilities

Despite a decrease in the number of domestic refineries from well over 200 in the early 1980s to less than 180 today, their throughput has been essentially constant at about 15 million barrels per day. This is the case because remaining refineries operate at increased capacities to compensate for the lack of production at decommissioned older refineries. However, refinery profit margins have decreased due to ever-increasing competition, and the number of refinery personnel has fallen significantly as operators seek to maximize output with minimum operating costs.

Thousands of above ground crude oil and refined product storage tanks are in service at refineries and other oil/product handling facilities. American Petroleum Institute (API) Standard 653 governs tank inspections and requires that tanks be taken out of service periodically and visually inspected for leaks. While used as a guide by nearly all facilities, this standard is often ignored since inspection can cost an estimated $100,000 per tank.

Buried pipelines within refinery boundaries represent another source of leaks, and according to the API, have led to more ground water contamination than the more visible storage tanks. API Standard 2610 provides procedures for operators to verify piping integrity - with most refinery operators relying on subsurface monitoring to detect leakage. As a result, the enhanced practices of recent years have significantly reduced releases from tanks and piping. Due to the decrease in federal oversight resources, however, inspections are not always carried out with the recommended frequency. These irregular inspection intervals, combined with the aging domestic refinery infrastructure, increase the risk of spillage and dictate that better procedures be developed to detect potential problems.

Another possible source of leakage is the refinery process line. Current refinery practices involve company-specific in-service inspection procedures based on API Standard 510, which requires a refinery to shut down so that inspections can be performed under ambient conditions. These inspections are typically manual and cost several million dollars a year for a typical refinery.

A long-term objective of refinery operators and government is the development of better survey methodologies for their physical plant. As a result, automated in-service petroleum tank and piping inspection devices are being developed. Though not in commercial service, these devices promise better inspections at lower costs. This will conceivably lead to more frequent inspections and a higher degree of confidence in the overall structural integrity of the facility. Additional developments being encouraged by the refiners are in-service inspection systems that can survey pressure boundary structures. These systems also hold promises for longer-term improvements in inspections at significantly reduced costs.

C. Quantification and Trends of Oil Spills

Data Availability and Uses

Why do spills occur and where can the greatest improvements be made? While the answers to these questions require an understanding of the oil transportation and production system, they also require an understanding of spill causes and effects. The more we know about the incidents - where, when, and how they have occurred - the better we will be able to determine how to prevent them. Therefore, to plan and prioritize future oil spill R&D activities, it is necessary to analyze some of the available oil spill statistics to determine the primary source, cause, location, size, and oil type of these spills.

Information relevant to answering the above questions and reducing the risk of oil spills is found in a number of federal databases which compile data produced under a variety of statutes and regulations mandating facilities and/or carriers to report pollution events. (The scope, data elements, and a general cross comparison of seven major federal databases containing spill data used in preparing this plan is included as Appendix B.) The databases are used for a variety of purposes in oil pollution prevention and response. These include:

- Supporting emergency planning activities;
- Identifying weaknesses in the oil transportation system;
- Performing risk analyses;
- Determining inspection priorities;
- Gauging results of technology changes and developing new technologies;
- Assessing results of regulatory programs and developing new spill prevention programs;
- Facilitating impact analyses on lives, property, and the environment;
- Guiding agencies' allocation of resources; and
- Supporting agency compliance and enforcement programs.

It is important to note, however, that differences exist among statutes with regard to whom reports must be made, threshold reporting requirements, when a report must be made, and what information must be included in the report. Coupled with these reporting incongruities is a lack of quality data regarding the causal chain of events that led to the spill. As a result there are significant data gaps and analysis limitations with regards to spill causes, spilled oil's fate and effect, and shipment information. Unfortunately, the data that do exist are not subjected to rigorous quality control, particularly for consistency of terms and definitions. Furthermore, these databases are not linked, making it very difficult for researchers to search in and compare multiple databases. Until a long-term solution is reached, no clear understanding of reality can be obtained. Ongoing efforts to make existing data more usable, available, and comparable need to continue.

The Coast Guard's Marine Safety Information System (MSIS) data represents spills reported to the Coast Guard by responsible parties, other private parties, government agencies, and Coast Guard personnel. All reported discharges into U.S. navigable waters, including territorial waters, tributaries, the contiguous zone, onto shorelines, or into other waters that threaten the aquatic environment of the United States are included. Since this database appears to give the best overall summary of trends in oil spill occurrences in navigable waters, it was used in conjunction with MMS data on OCS operations and Environmental Protection Agency (EPA) data on inland spills as the basis for establishing the plan's research and technology priorities. Available oil spill data were analyzed to determine trends in primary spill source, cause, size, location, and type of oil spilled.

Oil Spill Trends

Figure 2 shows clearly the downward trend in oil spilled as a function of domestic oil demand. Whether this is attributable to the heightened environmental awareness of the past 25 years or an increasingly effective campaign by political, economic, and regulatory agencies to protect our natural resources, it indicates that we are on the right track. However, we must still expect and plan for the periodic "disasters" that cause the peaks in the graph.

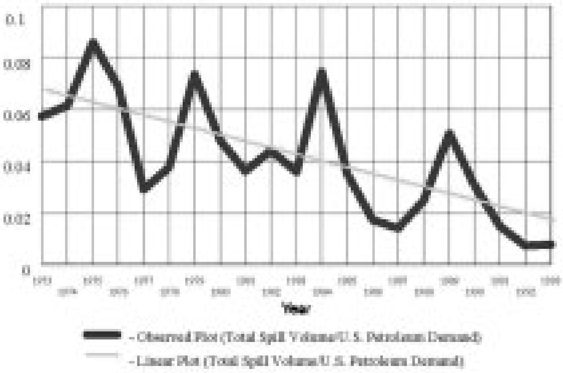

Figure 2 Oil Spillage as Percent of Domestic Oil Demand

MSIS oil spill data for each of the years 1973 through 1993 were analyzed by the U.S. Coast Guard[3] and led to several telling conclusions, the most important of which are listed below and/or presented in several of the plan's tables.

- The number of reported spills averaged approximately 8100 / year;
- Of these reported spills, 5% accounted for 95% of the spilled oil volume;
- Less than 0.2% of reported spills exceeded 100,000 gallons ("major spills");
- Tank ships, tank barges, and other vessels were the source of approximately 52% of the spilled oil volume; and
- Pipelines, facilities, and non-waterborne transport sources accounted for 48% of the spilled oil volume;
- 85% of the oil spilled into water occurred in the coastal and internal waters.

Tables 1 through 6 provide information regarding the sources, relative volumes, location, and contributing cause of oil spills in the waterborne transportation, Outer Continental Shelf, and inland regimes. It is important to bear in mind that the "cause" attributed to any of these spills is the final action or event that resulted in a pollution incident. Numerous reports over the past two decades estimate that from 60-80% of marine casualties result from "human errors" that occur somewhere in the event chain.

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[3] United States, Dept. of Transportation, U. S. Coast Guard, Pollution Incidents in and around U.S. Waters: A 25 Year Compendium 1969-1993 (Washington, DC. 1995).

One positive result of this high percentage, which is often yet viewed as conservative, is the generally accepted notion that most oil spills are preventable. Table 3 summarizes the causes of 88 tanker spills of 10,000 gallons or more in U.S. waters over a 15 year period. While fortunately a relatively small sample size, it reinforces the position that reducing human error (i.e. in ship handling and cargo operations) will prevent a significant amount of oil pollution. It is in this area that researchers and regulatory bodies are increasingly looking for advancements.

Table 1. Oil Spilled in U.S. Waters by Source (1973 - 1993)

Source: U.S. Coast Guard, 1995

Source	Number of Spills	Volume Spilled (millions of gallons)	Percent of Total Volume Spilled
Tank Ship	8,034	66	30
Tank Barge	12,765	38	17
All Other Vessels	38,778	12	5
Facility	48,295	40	18
Pipeline	7,813	39	18
All Other Non-Vessels	7,900	7	3
Unknown	46,755	19	9
Total	170,340	221	100

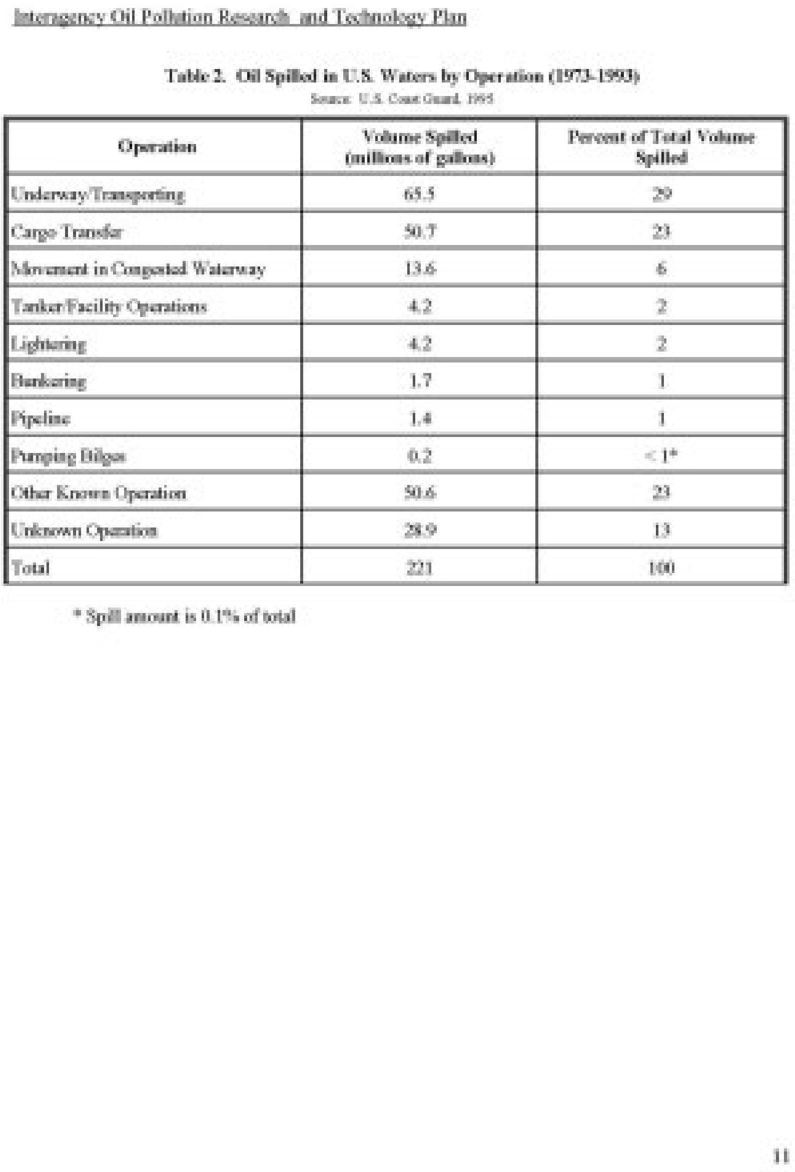

Table 2. Oil Spilled in U.S. Waters by Operation (1973-1993)

Source: U.S. Coast Guard, 1995

Operation	Volume Spilled (millions of gallons)	Percent of Total Volume Spilled
Underway/Transporting	65.5	29
Cargo Transfer	50.7	23
Movement in Congested Waterway	13.6	6
Tanker/Facility Operations	4.2	2
Lightering	4.2	2
Bunkering	1.7	1
Pipeline	1.4	1
Pumping Bilges	0.2	< 1*
Other Known Operation	50.6	23
Unknown Operation	28.9	13
Total	221	100

* Spill amount is 0.1% of total

Table 3. Causes of Tanker Spills in U.S. Waters of 10,000 Gallons or More (1978-1992)

Source: Golob, 1992

Cause	Number of Spills	Percent of Total Spills
Grounding	23	26
Collision	12	14
Cargo Transfer	12	14
Ramming	9	10
Structural Failure	8	9
Equipment Failure	8	9
Explosion/Fire	6	7
Other	10	11
Total	88	100

Table 4. Oil Spilled in U.S. Waters by Location (1973-1993)

Source: U.S. Coast Guard, 1995

Source	Volume Spilled (millions of gallons)	Percent of Total Volume Spilled
Internal/Headwaters	109	49
Coastal (0 - 3 mi.)	80	36
Contiguous Zone (3 -12 mi.)	3	1
Coastal Ocean (12 - 200 mi.)	21	10
General Ocean	2	1
Other	6	3
Total	221	100

Table 5. Sources of Oil Spills from Inland Transportation and Distribution System (1987-1995)

Source: EPA ERNS Database

Inland Source	Number of Spills	Volume Spilled (millions of gallons)	Percent of Total Volume Spilled
Fixed Facility	43,188	79.5	62
Pipeline	13,771	33.7	26
Highway Transport	13,280	6.2	5
Rail Transport	2483	3.7	3
Above Ground Storage Tank	921	4.4	3
Underground Storage Tank	795	0.5	<1
Total	74,438	128	100

Table 6. Causes of Oil Spills from Inland Transportation and Distribution System (1987-1995)

Source: EPA ERNS Database, (Statcorp, 1995)

Cause	Number of Spills	Volume Spilled (millions of gallons)	Percent of Total Volume Spilled
Equipment Failure	11,476	22.8	50
Operator Error	4,235	4.3	9
Transportation Accident	3,187	3.0	7
Natural Causes	583	1.7	4
Dumping	2,250	1.0	2
Other	2,584	2.3	5
Unknown	934	10.4	23
Total	25,249	45.5	100

D. Oil Spill Costs

Over the years, awareness of oil's detrimental environmental effects has increased and actions have been taken to reduce the volume of oil entering the environment accidentally. Yet despite improvements in spill prevention technology, accidents continue, sometimes with staggering environmental and economic consequences. To complicate matters, the cleanup technologies employed following a spill may also have negative environmental impacts. As a result, information that aids in a rapid assessment of the potential environmental impact from the spill and the proposed cleanup operations is essential to mitigating the damages. The following sections present some of the factors that need to be considered in developing an effective oil pollution research program.

Response, Property, and Environmental Costs

The costs resulting from a spill are numerous and include economic, social, recreational, and ecological losses. While spill response and property damage costs are relatively easy to identify, two of the biggest unknowns after any spill are the costs involved in restoring the environment to its pre-spill condition or compensating those who have been harmed by the spill. Claims are frequently made for losses to commercial enterprises such as fisheries, waterfront facilities, and tourist industries.

The expanded range of damages permitted by OPA 90 has resulted in an escalation of spill costs. The following illustrate some of the costs associated with oil spill response and restoration:

- The cost of recovering or eliminating oil offshore is typically 10 to 100 times less than removing the same oil from shorelines.[2]

- Cleanup costs for on-water physical containment and removal of oil with no significant shoreline average \$4.03 per gallon. Shoreline cleanup, wildlife rescue and rehabilitation, and other labor intensive operations can drive the cost up to as much as \$263 per gallon as was the case in the EXXON VALDEZ spill.[3]

- Federal agency costs for the EXXON VALDEZ 1989 cleanup season alone were \$110 million. EXXON's response costs exceeded \$2 billion.

- In response to the tank barge BERMAN spill off Puerto Rico in 1993, government response costs were over \$80 million with natural resource damage (NRD) costs still pending. In the case of the tank ship NAUTILUS off Staten Island in 1990, the potential responsible party's response costs were \$20 million with NRD costs of \$4 million.

- Union Oil of California spent \$13 million to clean up the oil and settle claims resulting from a 6300 gallon oil spill from a near shore pipeline in south-central California in 1992.

While it is generally accepted that the unit cost (i.e. \$/gallon) of an oil spill typically decreases with increasing volume, thus resulting in smaller spills having dramatically higher unit costs than larger spills, cleanup and restoration cost data on spills in the United States is scarce and non-centralized. In fact, actual response costs often only scratch the surface of a spill's overall net cost to the nation in lost productivity and opportunity.

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[2] Allen, A.A. and R.J. Ferek., Advantages and Disadvantages of Burning Spilled Oil, (Washington: API, 1993)
[3] Etkin, D.S., The Financial Costs of Oil Spills, (Arlington, MA: Cutter Information Corp., 1994)

Factors Exacerbating Physical and Biological Impacts to the Environment

The adverse environmental impacts and costs from an oil spill vary depending on a multitude of factors, each of which has the potential to exacerbate the impact of the spill on the surrounding community. This complexity makes it difficult to predict the severity of impact and to develop effective response and restoration techniques. The following sections discuss some of these factors.

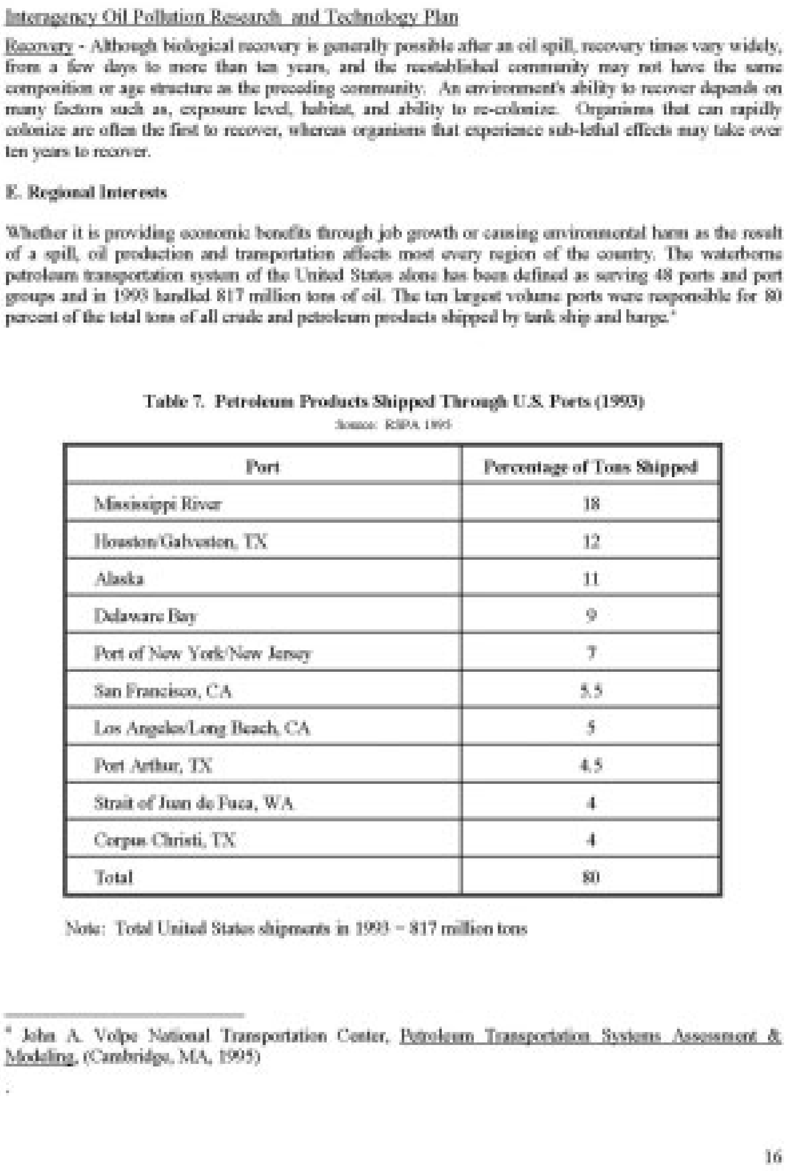
Oil Type and Behavior - The different physical and chemical properties of crude and refined oils influence the physical and biological effects of an oil spill. For example, lighter, highly toxic, refined products, i.e. jet fuels, which can cause immediate impact to organisms, often evaporate rapidly. Heavier oils, i.e. crude oils and heavy fuel oils, often form a thick oil and water mixture (emulsification) which clings to rocks, sand, and organisms, and can persist in the sediments for many years. Regardless of the type of oil, damage to the environment is increased if the volume of the spill is large or if the spill occurs in confined areas.

Another important factor in determining the potential harm to the environment is the degree to which the oil has been "weathered." Weathering is a series of chemical and physical changes that cause spilled oil to be altered through the natural processes of dissolution, evaporation, emulsification, and oxidation. For instance, when an oil spill occurs close to shore, it has an increased potential to cause harm because the oil does not weather significantly before it reaches shore, and as a result, still contains many toxic compounds. Weathering is also critical in determining the type of response method that will be effective. For example, emulsification retards the loss of toxic compounds through evaporation, and limits or prevents the use of dispersants or *in situ* burning. In addition, emulsification of a spill significantly increases the volume of oily liquid to be recovered, which exacerbates the problem of oil and debris disposal.

Environmental Sensitivity - The environment's sensitivity to oil varies depending on many factors including the composition of the oil, its concentration, the type of shoreline, and the amount of energy in the environment. These factors, in turn, impact the biological consequences. For instance, the environmental impact of a spill at sea is primarily on the surface layer and on those animals and plants that utilize that part of the water; research has shown that only under specific conditions is the oil likely to impact organisms living in the water column or on the ocean floor.

Organism Vulnerability - The amount and condition of the oil in the environment, and the organism's exposure, strongly influence the potential impact of a spill on organisms living in close proximity to the spill. For instance, oil spills have the potential to affect every level of the marine food chain, from the organisms that live in the sediments to those that float on the surface of the water. Various factors will determine what organisms are effected, the degree to which they are injured, and the rate at which they can recover. Included in these factors are season of the year, life stage of the organism, type of oil spilled, and duration of exposure.

Cleanup and Restoration - In addition to the incident characteristics affecting the severity of environmental impact, the actions taken to clean up the oil and to mitigate its effects are also crucial to determining the rapidity of environmental recovery and the injury remaining. For instance, some mechanical cleanup techniques can increase the severity of impact in certain environments, while some non-mechanical cleanup measures, if applied to the wrong environments, can similarly exacerbate environmental impact and slow recovery. Conversely, properly applied removal actions can facilitate recovery over no action. Understanding the balance between cleanup and cessation of cleanup, the match between removal activity and environment type, and the indicators of successful actions are basic to developing a truly effective oil spill response capability.



Recovery - Although biological recovery is generally possible after an oil spill, recovery times vary widely, from a few days to more than ten years, and the reestablished community may not have the same composition or age structure as the preceding community. An environment's ability to recover depends on many factors such as, exposure level, habitat, and ability to re-colonize. Organisms that can rapidly colonize are often the first to recover, whereas organisms that experience sub-lethal effects may take over ten years to recover.

E. Regional Interests

Whether it is providing economic benefits through job growth or causing environmental harm as the result of a spill, oil production and transportation affects most every region of the country. The waterborne petroleum transportation system of the United States alone has been defined as serving 48 ports and port groups and in 1993 handled 817 million tons of oil. The ten largest volume ports were responsible for 80 percent of the total tons of all crude and petroleum products shipped by tank ship and barge.[4]

Table 7. Petroleum Products Shipped Through U.S. Ports (1993)

Source: RSPA 1995

Port	Percentage of Tons Shipped
Mississippi River	18
Houston/Galveston, TX	12
Alaska	11
Delaware Bay	9
Port of New York/New Jersey	7
San Francisco, CA	5.5
Los Angeles/Long Beach, CA	5
Port Arthur, TX	4.5
Strait of Juan de Fuca, WA	4
Corpus Christi, TX	4
Total	80

Note: Total United States shipments in 1993 = 817 million tons

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[4] John A. Volpe National Transportation Center, Petroleum Transportation Systems Assessment & Modeling, (Cambridge, MA, 1995)

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The following summarizes briefly a few of the issues of regional interest. To address some of these concerns, Alaska, California, Louisiana, and Texas have developed active oil pollution research programs, as shown in the following table.

Table 8. State R&D Activities

State Program	Research Focus
Alaska, Prince William Sound Oil Spill Recovery Institute (OSRI).	Implemented an aggressive R&D program covering numerous technologies for prevention and response. Focus is on Arctic and Sub-Arctic environments. The Institute interacts with federal agencies through the OSRI Scientific and Technical Committee.
California Department of Fish and Game	Dispersant testing with Marine Response Spill Corporation (MSRC) including: toxicity of dispersed oil; effectiveness of dispersants on California oils; and kinetics of organism uptake of mechanically and chemically-dispersed oils). Effects of oil exposure on marine mammals and birds. Developing monitoring and treatment techniques for marine birds. Developing marine mammal & bird population assessment techniques and baseline data for California.
Louisiana, Applied Oil Spill Research and Development Program	A range of projects tailored to the Gulf Coast environment including: trajectory modeling; risk assessment; oil-water separation; *in situ* burning; bioremediation,; fate and effects; and restoration.
Texas General Land Office R&D Program	A range of projects including trajectory modeling, dispersant application, bioremediation, and shoreline cleanup. Primary sponsor for the Coastal Oil Spill Simulation System at Texas A&M University. Projects have been undertaken jointly with MSRC and federal agencies.

Gulf of Mexico

Proven oil reserves, an established production infrastructure, and a well-developed onshore refining and transportation system make the Gulf of Mexico a center for producing, refining, and transporting oil from a variety of sources. The importance of the oil and gas industry to the states of Louisiana and Texas cannot be overstated; the dramatic changes in the level of oil and gas activity over the past 20 years within the region, as well as that occurring elsewhere but supported by the region, caused large fluctuations in population, labor, and employment. As a result of the economic importance of the energy and marine industries to Gulf states, the area is very receptive to oil-related activity and development. (The area is also vital to national interests as it contains a high percentage of chemical production, the Strategic Petroleum Reserve, and the Louisiana Offshore Oil Port (LOOP), the only deep water oil terminal in the nation.)

Transportation of oil and gas from offshore facilities in the Gulf of Mexico has traditionally relied on an ever-expanding pipeline network. While industry has discussed the use of shuttle tankers to transport oil from deep water leases to shore, such a plan has not been implemented to date. Consequently most of the oil and gas produced in the region will continue to be transported to the shore by pipeline for the foreseeable future. This fact raises the concern about the structural integrity of the pipelines and the adequacy of leak monitoring methods. Of considerable environmental concern is the possible impact on the numerous marshes and swamps in the region. Since there is little natural flushing in the marshes, a large spill could be catastrophic. Both Louisiana and Texas have been active in pre-approving alternative spill response cleanup measures.

Lightering of oil from "supertankers" to shallower draft tank ships capable of entering the coastal and river ports of Texas and Louisiana will continue to grow in frequency as the demand for imported oil climbs. While this activity has generally been a low risk, it should not be ignored.

West Coast

Economic interests similar to those in the Gulf exist in central and southern California where there are numerous onshore oil wells and refineries, but the state's economy is more diversified and not as dependent on the oil and gas sector. While California has a long history of offshore oil production, environmental concerns since the 1969 Santa Barbara Channel spill have led to strict limits on its growth and virtually stopped new exploration and development. Washington continues to refine a significant amount of oil, particularly Alaskan North Slope crude, much of which supplies regional demand, and shares with California a similar view towards offshore exploration and development. Finally, the States/British Columbia Task Force serves as a forum for the states of Alaska, California, Oregon, and Washington, along with British Columbia, to address common concerns related to spill risks and protection of marine resources.

Alaska

Alaska's economy is directly tied to the vitality of the oil and gas industry due to the large amount of production on the North Slope and in Cook Inlet. Prospects of future production from the Beaufort Sea raise concerns about spill prevention, response, and cleanup in an ice-covered regime with which we have relatively little experience. However, tourism and fishing are also vital to the state's economy and require a clean environment to be successful. The state is working hard to balance the needs of all sectors and to protect as much of its pristine area as possible.

Much of the oil produced in Alaska is shipped through areas which are environmentally sensitive due to the presence of fish hatcheries and spawning grounds. There is also great concern over the potential effects on the permafrost that could result from pipeline spills. The Prince William Sound Oil Spill Recovery Institute (also authorized by OPA 90) is working to identify and develop the best available technologies to deal with oil spills in the Arctic and Subarctic environments.

East Coast and Great Lakes

In contrast to the other coasts, the Atlantic and Great Lakes areas have no primary offshore production facilities. As a result, these regions of the country are affected primarily by the importation and refinement of crude oil and transportation of its products. Delaware Bay and New York/New Jersey are the main oil port areas on the East Coast. Coastal tank ships and barges and extensive pipeline networks move crude oil and products to their distribution points. Protection of the Atlantic fisheries and beaches, and Florida's coral reefs are major concerns.

In the Great Lakes region, Joliet, IL; Lamont, IL; Whiting, IN; St. Paul, MN; and Toledo, OH; have the largest refineries, each with the capacity to process over 100,000 barrels of oil per day. This oil arrives in the region largely by pipeline, including significant imports from the Canadian provinces to the west. Product distribution within the region is by pipeline, barge, rail, and truck.

2. Research and Technology Programs - Accomplishments and Potential Benefits

This section describes the progress made in the various technology areas outlined under the original Interagency Oil Spill Research & Technology Plan, including an assessment of current technology based on accomplishments since the passage of OPA 90, and recommends future program directions. Four categories where improvements in technology can lead to the attainment of a significant goal are:

- Spill Prevention - Reduce the number and volume of spills by addressing items in the causal chain of events that result in spills.
- Spill Response Planning, Training, and Management - Improve the effectiveness of response through better coordination and pre-spill planning.
- Spill Countermeasures and Cleanup - Improve the ability of responders to remove oil without causing further environmental injury.
- Fate, Transport and Effects (FTE), Monitoring and Restoration - Improve the ability to predict movement and impacts of oil spills and restore the environment to its pre-spill condition.

The overall objective of oil pollution research and technology is to minimize the likelihood and impacts of accidents. In each of the above areas, the technologies and procedures must be re-examined to ensure that the most current information is used, especially in light of the changes which have occurred since the passage of OPA 90.

The first portion of this section describes the activities and responsibilities of the various agencies on the Interagency R&D Committee, highlighting specific accomplishments in meeting the mandates of OPA 90 and advancing the nation's capability to prevent and respond to spills. Included in this discussion is a brief summary of current research activities and future development opportunities in each of the four technology areas. Detailed descriptions of the state-of-the-technology and future research required for each specific technology are contained in a series of technology assessment and forecast summaries contained in Appendix A.

The second portion of this section looks at the individual technology areas in these four categories, and qualitatively assesses their potential impact for limiting oil pollution and its effects. Although research was initiated to better quantify the risks of oil spills associated with the marine transportation system and the impact of technological advances, the work is incomplete. Consequently, while these assessments fall short of providing the rigorous cost/benefit analysis for each technology area called for by the National Research Council Report (NRC, 1993), they do provide a basis for identifying major shortfalls in the federal oil spill research and technology development program and assigning relative priorities.

A. Overview of Federal Efforts and Accomplishments

Before summarizing the current status and future directions for each technology area, it is helpful to review the research focus areas of the various federal agencies, highlighting specific accomplishments aimed at fulfilling the expectations of OPA 90. Since the passage of OPA 90 and the resultant revitalization of the nation's R&D efforts to control oil pollution, the agencies of the Interagency Coordinating Committee on Oil Pollution Research have pursued R&D programs consistent with their level of appropriated funds. As envisioned in the original R&D Plan, agencies have focused their efforts on areas appropriate to their regulatory and operational responsibilities. These major focus areas are outlined in the following table.

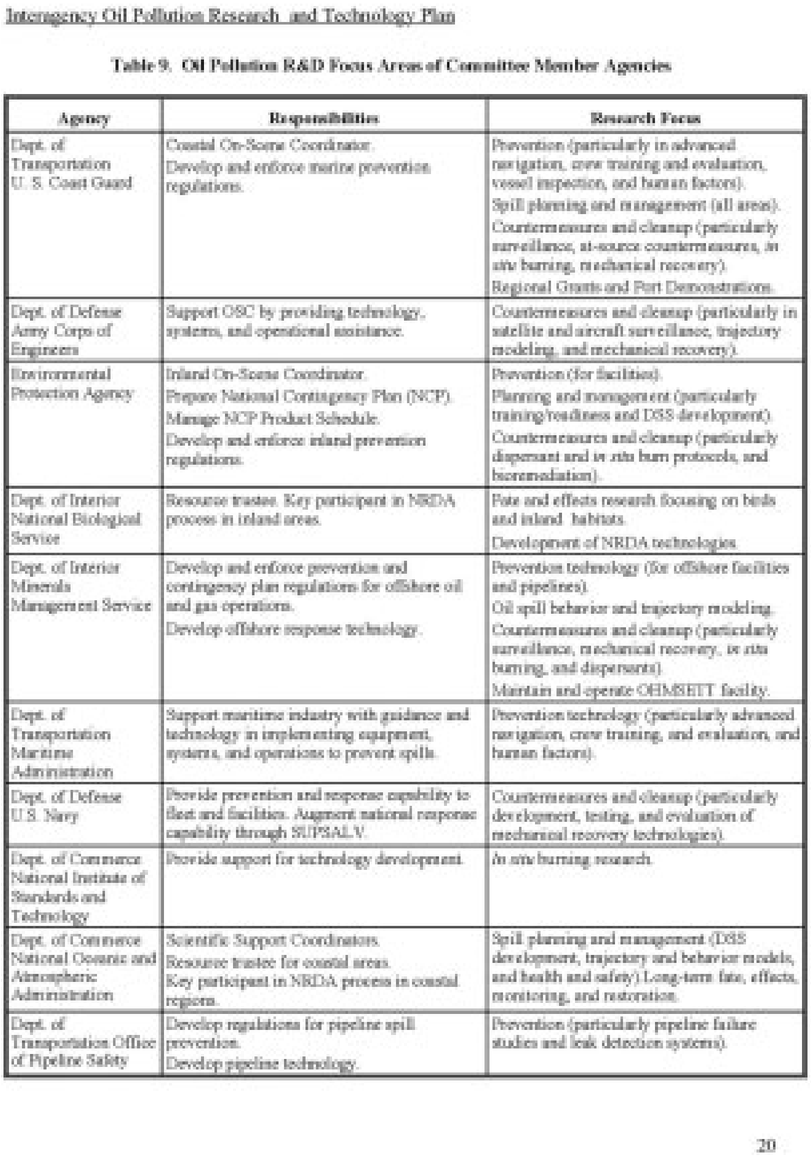

Table 9. Oil Pollution R&D Focus Areas of Committee Member Agencies

Agency	Responsibilities	Research Focus
Dept. of Transportation U. S. Coast Guard	Coastal On-Scene Coordinator. Develop and enforce marine prevention regulations.	Prevention (particularly in advanced navigation, crew training and evaluation, vessel inspection, and human factors). Spill planning and management (all areas). Countermeasures and cleanup (particularly surveillance, at-source countermeasures, *in situ* burning, mechanical recovery). Regional Grants and Port Demonstrations.
Dept. of Defense Army Corps of Engineers	Support OSC by providing technology, systems, and operational assistance.	Countermeasures and cleanup (particularly in satellite and aircraft surveillance, trajectory modeling, and mechanical recovery).
Environmental Protection Agency	Inland On-Scene Coordinator. Prepare National Contingency Plan (NCP). Manage NCP Product Schedule. Develop and enforce inland prevention regulations.	Prevention (for facilities). Planning and management (particularly training/readiness and DSS development). Countermeasures and cleanup (particularly dispersant and *in situ* burn protocols, and bioremediation).
Dept. of Interior National Biological Service	Resource trustee. Key participant in NRDA process in inland areas.	Fate and effects research focusing on birds and inland habitats. Development of NRDA technologies.
Dept. of Interior Minerals Management Service	Develop and enforce prevention and contingency plan regulations for offshore oil and gas operations. Develop offshore response technology.	Prevention technology (for offshore facilities and pipelines). Oil spill behavior and trajectory modeling. Countermeasures and cleanup (particularly surveillance, mechanical recovery, *in situ* burning, and dispersants). Maintain and operate OHMSETT facility.
Dept. of Transportation Maritime Administration	Support maritime industry with guidance and technology in implementing equipment, systems, and operations to prevent spills.	Prevention technology (particularly advanced navigation, crew training, and evaluation, and human factors).
Dept. of Defense U.S. Navy	Provide prevention and response capability to fleet and facilities. Augment national response capability through SUPSALV.	Countermeasures and cleanup (particularly development, testing, and evaluation of mechanical recovery technologies).
Dept. of Commerce National Institute of Standards and Technology	Provide support for technology development.	*In situ* burning research.
Dept. of Commerce National Oceanic and Atmospheric Administration	Scientific Support Coordinators. Resource trustee for coastal areas. Key participant in NRDA process in coastal regions.	Spill planning and management (DSS development, trajectory and behavior models, and health and safety).Long-term fate, effects, monitoring, and restoration.
Dept. of Transportation Office of Pipeline Safety	Develop regulations for pipeline spill prevention. Develop pipeline technology.	Prevention (particularly pipeline failure studies and leak detection systems).

Interagency Oil Pollution Research and Technology Plan

The various agencies have been active in rebuilding the nation's research infrastructure, including the refurbishment and reopening of OHMSETT at The National Oil Spill Response Test Facility - located in Leonardo, NJ. This is the only facility in the world where full-scale oil spill response techniques and equipment can be tested, with oil, under controlled conditions. It is managed by the Minerals Management Service (MMS), and operated by a private contractor. A $1.5 million refurbishment program, funded by MMS, the Coast Guard, and Environment Canada, was completed in 1992, and extended the life of the facility by an estimated 15 to 20 years. To date, 16 separate test series have been carried out at the facility to test booms, skimmers, temporary storage devices, sorbents, and remote sensing systems. OHMSETT is a critical resource for continuing oil spill technology development.

The agencies have also been active in enlisting the capabilities of the nation's universities and non-profit organizations in oil spill research and technology development. In 1994 the Coast Guard initiated the OPA 90 Regional Grants Program, administered through the Volpe National Transportation Systems Center, with the distribution of $837K to fund ten projects.[7] An additional $584K was distributed in 1995 to fund seven additional research efforts. The Coast Guard also provided funding to Massachusetts Maritime Academy, Texas A&M University, and New York Maritime Academy ($1.25M each) for oil spill response training simulator development. Although the primary function of these facilities is hands-on training, there are research applications as well.

To further address regional technology development issues, the Coast Guard funded the establishment of the South Florida Oil Spill Research Center at the University of Miami to conduct research on oil spills in tropical and sub-tropical environments.[8] In addition, the Army Corps of Engineers is funding a research grant at the University of Miami to investigate restoration and remediation plans on the Gulf Coast. Various federal agencies also provided consultation to the Prince William Sound Research Institute, which focuses on oil spill research for Arctic and sub-Arctic regions. Focus areas for Arctic research include *in situ* burning, spill cleanup in broken ice, remote sensing for tracking oil in and under ice, incineration of wastes, and fate and effects on Arctic ecosystems.

Additionally, various agencies provided funding and support to small businesses and entrepreneurs through small business set-aside contracts and Small Business Innovative Research (SBIR) program grants for development of innovative oil spill prevention and response technologies. Logistic support was also provided to small companies for testing various technologies at OHMSETT and in the field.

The agencies are also addressing the issue of the public's perception of oil spill technology. The EXXON VALDEZ incident left the public with the perception that oil spill response technology was primitive and totally inadequate. As long as that perception persists, the success of R&D efforts will not be recognized. As a result, the National Research Council expressed the need for public education and involvement in formulating the federal oil spill R&D strategy. Various agencies have pursued programs to inform the public of the true capabilities of oil spill prevention and response technology through workshops, seminars, and publications. The Interagency Committee provided government agencies and the public the opportunity to learn about new technologies through the Port Demonstration Projects called for by OPA 90. Port Demonstrations were held in New Orleans (December 1994) and New York (October 1995).

In pursuing their oil pollution-related R&D programs, the agencies make every attempt to coordinate their efforts, and in many cases actually conduct projects, with the states and industry. This limits duplication of effort, and allows for the leveraging of funds. The state R&D programs were presented earlier in Table 8;

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[7] Putukian, J., and K. Bitting, U.S. Coast Guard Oil Pollution Research Grant Program, (London: Intype, 1995).

[8] C.N.K. Mooers, South Florida Oil Spill Research Center, (London: Intype, 1995).

Interagency Oil Pollution Research and Technology Plan

Table 10 provides a summary of industry programs. Both state and industry programs are monitored by the Interagency Committee, and cooperative efforts are undertaken when possible. It should be noted that the state and industry programs look to the federal program for leadership and support, and that both state governments and industry are also experiencing the cyclic decline in research programs due to budget reductions and the shift in Congressional and public emphasis. A healthy Federal Oil Spill R&D Program could help maintain the level of state and industry participation in oil pollution research.

Table 10. Industry R&D Activities

Industry Program	Research Focus
Marine Spill Response Corporation	MSRC conducted a $30M R&D effort which was terminated at the end of 1995. It addressed many of the planning and management areas, and most of the countermeasures and cleanup technology areas in the marine and coastal environments. Emphasis was placed on behavior modeling, worker health and safety, airborne remote sensing, mechanical recovery, dispersants, *in situ* burning, oil and debris disposal, and fate and effects.
American Petroleum Institute	While MSRC program was in place, API focused on inland/ freshwater spills. Specific research areas include chemical countermeasures, *in situ* burning for habitat restoration and oil removal, developing a manual for inland shoreline cleanup, and human and ecological effects of oil. A Marine Research Workgroup was formed in early 1996 to continue work in the marine environment and carry on promising projects from the MSRC program (i.e. dispersant field tests, collection of toxicity data, risk communication, and *in situ* burning.)
Petroleum Environmental Research Forum	PERF is an ad-hoc industry oil spill R&D group. Projects have focused on developing guidelines for studying oil spill effects, evaluation of oil solidifiers, and the evaluation of biosurfactants (joint project with EPA).

In addition to coordinating with the states and industry, the Interagency Committee has endeavored to maintain contact and cooperate with other countries' oil spill R&D programs. Communication, technology transfer, and joint project development have increased significantly since OPA 90. A worldwide oil spill R&D database now exists and is useful in identifying scientists and programs for cooperative efforts. Joint projects are routinely undertaken with Environment Canada, Warren Spring Laboratory and its successor, the National Environmental Technology Center in the United Kingdom, and SINTEF in Norway. In addition, two International R&D Forums have been held; one at Tyson's Corner, Virginia in 1993, and the second in London in 1995. The proceedings for these forums record international progress in oil spill R&D. These forums also have fostered cooperative programs and coordinating groups that leverage resources and accelerate R&D advances. In fact, the results of the London Forum were used as the basis for R&D priorities in this report.

Interagency Oil Pollution Research and Technology Plan

Most notably, the Interagency Committee has registered a number of accomplishments in the prevention and response areas. These include specific advances in the various technology areas, and overall progress in rebuilding the national infrastructure and research capability in this area. Although this progress is encouraging, it also underscores the need for a sustainable level of oil pollution research as recommended by the National Research Council. This will stem the cyclic decline that is already underway as national interest shifts to other issues. Specific advances and future directions in the four technology areas are summarized below, and further described in the technology assessment and forecast summaries in Appendix A.

Spill Prevention

In the category of spill prevention, safety improvements have been made through the development of Electronic Chart Display Information Systems (ECDIS) and Shipboard Piloting Expert Systems (SPES) to facilitate vessel navigation, and Automated Dependent Surveillance Systems (ADSS) for vessel traffic monitoring and control. These technologies are well into the prototype development phase and are now moving into the test, evaluation, and implementation phases. Once fully implemented, these technologies could reduce major marine transportation accidents such as groundings and collisions.

Some progress has also been made in understanding the important role of human factors in spill prevention. A number of R&D initiatives are currently focused on this critical area, particularly relative to the marine transportation regime. These research efforts are being pursued primarily by the Coast Guard and Maritime Administration.

In the area of offshore operations spill prevention, the Minerals Management Service is carrying out an aggressive research program which focuses on the structural integrity of offshore structures and pipelines, well-control technology, risk-based management of offshore pipeline systems, and the role of human factors in offshore operations accidents.

Another important prevention area, but one which has received less attention, is spill prevention at onshore transfer, storage, and distribution facilities. A substantial volume of spilled oil originates from these facilities, often from easily preventable causes. This will be a key focus area for future projects.

Spill Response Planning, Training, and Management

In regard to spill response planning, training, and management, the Coast Guard is making advances in developing training and readiness evaluation systems using advanced computer technology. These systems are now providing basic spill response training at several locations around the country. Future efforts in the development process will fully integrate these systems into the national oil spill training and evaluation program. Computer technology has also been employed to develop prototype decision support systems (DSS) for contingency planning and response. Initial efforts, primarily by the Coast Guard, NOAA, and the Corps of Engineers have focused on developing the individual components of these systems, including advanced models and databases, as well as mapping and display tools. These components are being incorporated into a prototype DSS to provide accurate and accessible information to the spill responder. Future efforts will be directed at developing additional required components, refining the DSS system design, and fully integrating the technology into contingency planning, readiness training, and response management functions.

Spill Countermeasures and Cleanup

Advances in this area have centered on improving the effectiveness of various techniques, particularly those which can be employed at major spills. These efforts are being pursued primarily by the Coast Guard, Army Corps of Engineers, MMS, and EPA. For instance airborne remote sensing efforts seek to achieve a 24-hour, all-weather capability that allows response managers to not only map the perimeter of a spill, but to direct cleanup resources to the areas where they are most needed. The day/night, all-weather capability has been enhanced by upgrades and testing of synthetic aperture radar (SAR) and infrared sensors. In addition, a prototype laser fluorosensor has been developed and is being tested to positively discriminate between hydrocarbons and natural materials. Efforts are also continuing to develop a viable oil thickness sensor to allow mapping of heavier oil concentrations. The development, testing, and implementation of these sensors will provide a complete surveillance capability for oil pollution detection and enforcement, as well as oil spill response.

Since OPA 90, R&D in containment and removal technology has recognized the importance of containing the oil at the source and removing it from the water before it reaches shore, where environmental and cleanup costs are substantially greater. Mechanical recovery development efforts have produced viable Vessel of Opportunity Skimming Systems (VOSS), and a lightweight, high volume oil-water separator which increases the amount of oil recovered during skimming operations. Future R&D will focus on the recovery of oil in higher sea states and currents, and dealing with problematic oils, such as heavy Group V oils and orimulsions.

Advances have also been made in refining the technology of *in situ* burning. A multiyear R&D effort examining the potential of this technique culminated in an internationally funded and executed *in situ* burn experiment off Newfoundland in August 1993. This and other studies have demonstrated the fundamental soundness of *in situ* burning as an effective cleanup technique. However, to realize its operational benefits, research is needed to increase the durability of the required fire resistant booms, reduce smoke production, enhance other implementing technologies, and define the criteria for employment of this response technique.

The EXXON VALDEZ and other major spills of that period underscored the ineffectiveness of then available shoreline cleanup technologies. While some current methods remain expensive, labor intensive, and often environmentally damaging, significant progress has been made in this area. R&D efforts are defining which techniques should be used for various oil types and shoreline characteristics to achieve optimum removal, while minimizing environmental damage. For instance, findings from an EPA-funded Delaware study proved the effectiveness of bioremediation, and preliminary bioremediation implementation guidelines were developed based on the continued presence or absence of nutrients in the contaminated area. In addition, the minimum nutrient concentrations needed to maximize biostimulation were defined, and the frequency of addition of water soluble fertilizer was established based on water coverage in the inter-tidal zone. First order rates of biodegradation on sandy marine beaches in a temperate climate were developed for use in predictive models, and an important link between biodegradation rates measured in the field and those measured in the laboratory was established. More R&D is needed, however, before this technology reaches its full potential. Future efforts should address bioremediation of wetland ecosystems (both freshwater and saltwater), inland lacustrine and riverine shorelines, subsurface oil (for which no effective technique exists), and the development of alternative endpoints of risk to the ecosystem.

Fate, Transport and Effects, Monitoring and Restoration

Extensive research efforts, such as those undertaken by NOAA, EPA, and other federal agencies following the EXXON VALDEZ and Persian Gulf spills, are contributing greatly to the knowledge and understanding of the fate and effects of oil, different cleanup techniques, and longer-term ecosystem injury and recovery. However, follow-up studies are not conducted at most spills to evaluate the effectiveness of cleanup in mitigating impact and facilitating recovery. Monitoring of future spills must be conducted on a more routine basis in order to develop and refine cleanup protocols that maximize benefits to the environment. Additionally, future R&D must be directed at developing and testing viable and cost-effective ecosystem restoration techniques. Restoration activities are required by OPA 90, but technology and the scientific understanding to support this is minimal due to present funding constraints.

B. Assessment of Technology Advancement Potential

Since the rash of accidents that led to the passage of OPA 90, much of the research and technology development effort has been devoted to response, specifically response planning and management, countermeasures, and cleanup. This development was brought about in part by the public's attention being focused on the issue of oil spills primarily during the highly visible response phase. Much less attention has been given to prevention technologies which can also have a significant impact on the frequency and severity of oil spills. In developing a balanced oil spill research and technology plan, it is necessary to consider the relative role and significance of all technology areas.

Table 11 lists promising oil pollution technology areas identified by the Committee and other interested members of the oil pollution community, and makes a qualitative assessment (high, moderate, or low) of the relative impact of each. These assessments are based on the Committee's evaluation of the previously presented spill data, with a focus on the volume of oil spilled at different stages in the oil production and transportation system and the mode of transport. The Committee also considered response technologies that in their view had a significant impact at recent major spills, or could have had a greater impact if they had been more developed at the time. Detailed descriptions of each technology area is found in Appendix A.

Table 11. Oil Pollution Technologies and Their Advancement Potential

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
Spill Prevention				
Human Factors	Develop crew training protocols and systems, focusing on "team" vs. individual performance. Test alternative work schedules to address impacts of fatigue and sleep loss. Develop training technologies for automated vessels. Develop instrumentation for real-time testing of fitness for duty.	Conservatively, 60-80% of marine casualties result from "human errors" occurring somewhere in the causal event chain. Anything that can be done from a training, operational, or managerial standpoint to reduce these errors will prevent spills and negate the need for response and restoration.	Improved and more readily available ship simulators and training programs that build teamwork. Work routines and manning schedules that minimize effects of fatigue. Clearer understanding of the role increased automation and reduced crew complements have on safety. Real-time testing could identify alertness problems before accidents occur.	High
Offshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention	Develop enhanced inspection, repair, leak detection, and well control technologies. Develop improved pipeline inspection, monitoring, and control technologies, ie. "smart pigs". Investigate ice hazards associated with operations in Arctic environment.	New domestic offshore oil/gas development is occurring in much deeper waters that requires new technologies. 98% of OCS related spills greater than 50 barrels are from pipelines. While most are from external damage, pipeline system is aging. The Arctic is being looked at to provide more domestic oil. The technical challenges posed by operating there, and in deep Arctic waters must be examined.	Improved capabilities to monitor and assess potential problem areas, particularly pipelines, and prevent spills.	High

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
Onshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention	Develop improved leak detection and inspection technologies, ie. "smart pigs," acoustic examinations. (Work in concert with similar efforts in offshore applications)	Fixed facilities account for over 60% of oil spilled from inland sources with 50% due to equipment failure. 25% of oil spilled from inland sources is from pipelines. Undetected leakage from pipelines and storage tanks poses significant risks to drinking water, wetlands, and waterways.	Improved capabilities to monitor and assess potential problem areas, particularly pipelines and storage tanks, and prevent spills.	High
Navigation and Waterways Management	Integration of shipboard expert piloting systems (SEPS) and electronic chart display and information systems (ECDIS) Develop advanced automated dependent surveillance systems (ADS)	35% of spilled oil results from accidents while a vessel is underway, transporting, or moving in a congested waterway. 40% of major spills (1978-1992) resulted from grounding or collision. Improving the quality and availability of navigational information, as well as the ability to monitor vessel movements, can lower the risks of these accidents.	Improved vessel traffic systems at relatively low cost. Sensor and alarm systems to warn bridge personnel of potential danger and suggest corrective actions. Waterways risk assessment tools. Improved navigation tools integrated with ship onboard systems.	Moderate
Vessel Design	Develop advanced models for evaluating tanker design. Test and evaluate alternatives to double hulls.	40% of major spills (1978-1992) resulted from grounding or collision. Improving a vessel's ability to resist damage in these situations would minimize oil spillage. Much of the world tanker fleet needs replacing before 2015. New designs must be evaluated from a spill prevention standpoint. IMO accepts double hull alternatives. This issue remains open and alternatives should be evaluated.	Advanced models for evaluating a tanker and barge design's ability to resist damage in grounding or collision.	Moderate

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
Spill Response Planning, Training, and Management				
Decision Support Systems for Contingency Planning and Response	Further development of "first generation" systems to incorporate expert systems and evolving artificial intelligence technologies.	Lessons learned from past spill responses provide valuable insights for planning and responding to new spills. These tools improve response efficiency, limiting impact and costs. Maintains knowledge base despite turnovers in command/control and response personnel.	Improved and accelerated decision making with a more comprehensive operations management system.	High
Spill Trajectory and Behavior Prediction	Link existing models with real-time data. Develop data input and verification protocols.	This information provides the framework for oil spill planning and response activities.	Improved models' predictive capabilities, risk assessment potential, and, thereby, effectiveness of response operations.	High
Training and Readiness Evaluation	Develop, test, and evaluate a "Spills of National Significance" (SONS) simulator.	OPA 90 mandates an ongoing evaluation of the nation's preparedness for response. Simulator technology permits a more realistic assessment of readiness and allows responders to hone their skills without spilling oil.	A simulator capable of testing spill response preparedness for a large geographic area, involving numerous agencies and organizations.	Moderate
Personnel Health and Safety	Perform toxicity studies of crude oils and hydrocarbons. Develop health and safety protocols and an associated database.	Federal On Scene Coordinators and private responders are responsible for safeguarding the immediate and long-term health of cleanup personnel.	Standardized site safety assessments, plans, and monitoring procedures.	Low

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
Spill Countermeasures and Cleanup				
Dispersants	Field testing and evaluation of dispersants.	Dispersants can be very important in specific scenarios to protect sensitive resources. While not routinely used in the U.S, dispersants are being incorporated in many regional contingency plans. There is wider acceptance in Europe. Impact could be high if fate and effects for pre-approval and public awareness increases.	Refinement of dispersant application procedures and parameters for usage. Compilation of operational and technical data on dispersants.	High
In situ Burning	Improve fire boom design and materials, develop test protocols and test. Develop soot reduction techniques and simplified air plume models. Develop health and safety protocols and monitoring instrumentation.	Very promising technology for quick and efficient removal of large amounts of oil from water surface in offshore spills. Has coastal and inland applications as well. Technology is operational, included in many area contingency plans, and needs refinements to reach full potential.	More durable fire booms capable of operating in rough seas. Protocols for use and monitoring.	High
Oil Spill Surveillance	Develop sensor integration and data analysis techniques. Refine frequency scanning radiometer. Further development and testing of laser fluorosensor.	Development and integration of these tools can improve the efficiency of spill response by locating oil slicks, determining concentrations and properties, and tracking movements.	Integrated suite of sensors and analytical techniques to support spill response operations.	High

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
Shoreline Countermeasures and Cleanup	Develop protocols and effectiveness database for shoreline cleanup techniques. Refine techniques for removal of subsurface oil.	The shoreline impacts of oil spills are often the most damaging, costly, and long-lasting. Removal techniques for subsurface oil are labor intensive, destructive to the environment, and often ineffective. Past research by government and industry should be built upon to refine techniques in this area and expand the knowledge base.	Clearer understanding of available cleanup techniques and their relative effectiveness, and the dissemination of this information. Techniques to remove or mitigate subsurface oil.	High
Oily / Oiled Waste Disposal	Develop criteria and guidelines for land farming of waste. Develop mobile incinerators.	Landfilling of oily wastes is becoming more difficult and expensive due to hazardous waste regulations. Waste from spills in remote areas pose significant logistical problems.	Wider array of options for disposing of oily waste through physical, biological, and chemical means.	Moderate
On-Water Containment and Recovery	Develop high seas and current booms and skimmers. Improve oil/water separators. Develop techniques for recovery of submerged oils and orimulsions.	Research in these areas indicates that significant improvements are feasible. The potential future importation of orimulsions as an energy source calls for preliminary research into response techniques. Advances here will lead to higher percentages of recovered oil.	Booms and skimmers capable of working in high seas and fast currents (up to 3 knots). Ability to respond effectively to sinking oils and orimulsions.	Moderate
Alternative On-Water Countermeasures	Field testing and evaluation of emulsion treating agents.	Oil emulsions significantly reduce the effectiveness of mechanical recovery, *in situ* burning, and dispersant applications.	Establishment of a testing and evaluation program for emulsion treating agents.	Low

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
At-Source Containment and Countermeasures	Develop and test passive onboard countermeasures.	Minimizing the discharge of oil from a damaged vessel prior to arrival of outside response equipment will reduce cleanup cost and environmental damage. Prior studies have ruled out active measures due to manning, logistics, and safety concerns.	Operationally and economically viable passive response systems that can be integrated into vessel design.	Low
Vessel Damage Assessment and Salvage	Refine remotely operated vehicles (ROV) for underwater assessment of hull damage.	Initial study by Coast Guard indicates feasibility of a "hull crawling" vehicle. Primary application in adverse weather or other hazardous situations.	Functional prototype ROV for salvage assessment when divers or other tools are not practical.	Low
Fate, Transport and Effects, Monitoring and Restoration				
Restoration Methods and Technologies	Develop restoration indicators and measures of effectiveness. Develop restoration techniques, protocols, and an associated database. Establish "spill of opportunity" and laboratory research programs.	OPA 90 mandates restoration activities but current technology is primitive. Techniques are needed to address the wide range of shoreline types and conditions, as well as wetland areas.	Development of actual restoration methods and defining indicators of habitat impact and recovery.	High
Spill Impacts and Ecosystem Recovery	Establish monitoring protocols and procedures. Conduct laboratory and mesoscale studies of impact and recovery from different oil types. Establish integrated database of spill impact and recovery.	Long-term monitoring is essential for understanding the effectiveness of countermeasures and cleanup techniques, and assessing natural resource damage. Ecosystem impact and recovery may evolve over many years.	A coordinated and comprehensive long-term oil pollution effects monitoring program. Cost effective and environmentally sound cleanup measures tailored to environment, oil type, and incident conditions.	High

Technology Area	Recommended Research	Rationale	Anticipated Technology Advance	Potential Impact
Basic Fate and Transport	Determine behavior and transport, of subsurface oil. Refine understanding of transport/ behavior of subsurface oil.	Spills of low API gravity oils (LAPIO), Group V fuel oils, and orimulsions present unique problems. Behavior of subsurface oil must be understood to develop effective response plans and countermeasures.	Integration of information about LAPIOs and orimulsions into response plans. Operational methods to remove subsurface oil with acceptable environmental impact.	Moderate

3. Research and Technology Priorities

Recent government and industry data show that the volume of oil spilled in United States waters continues to remain far below that of the 1980s. Coast Guard figures indicate that the volume of oil spilled from maritime sources has dropped by approximately 77% since 1990, to an annual average of 1.4 million gallons for the 5 years . This is attributed primarily to the absence of any massive tankship spills since the Mega Borg in 1990. While this trend is encouraging, oil pollution is still a problem and must be addressed. The potential catastrophic damage that can result from a single major tankship or pipeline spill alone warrants continued investment in oil pollution R&D.

The Committee has identified many of the oil pollution technology gaps by examining the oil production and transportation system and the various factors which lead to and result from oil spills. While the technologies listed in Appendix A all constitute valid R&D, foreseeable budgetary constraints dictate that the areas be prioritized. Historically, a large percentage of available resources was used in the spill response category. The Committee agrees with the prevailing opinion that preventing spills is preferable to responding to them and that more resources should be shifted into the spill prevention area. Since it is unlikely that spills will ever be eliminated, preparedness, response, and restoration remain important research areas as advancements can minimize the impacts of spilled oil. Because this plan serves as a strategic planning document, the R&D requirements are identified at the program level. Project determinations will be made by the various program managers after the plan is approved and resource levels allocated.

In making this prioritization the Committee looked at the status of technologies to see which are either available now or should be available within five years if ongoing R&D is completed. These areas are grouped by a subjective estimate of their potential for either reducing the amount of oil spilled or its environmental impact over the next 5-10 years. (Level 1 represents the highest priority and Level 3 the lowest.) While the consensus of researcher opinions presented and discussed at the Second International R&D Forum in May,1995 were considered, the following priorities represent the views of the Committee.

Level 1 Priority:

- Human Factors;
- Offshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention;
- Onshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention;
- Decision Support Systems for Contingency Planning and Response;
- Spill Trajectory and Behavior Prediction;
- Dispersants;
- *In situ* Burning;
- Oil Spill Surveillance;

- Shoreline Countermeasures and Cleanup;
- Restoration Methods and Technologies; and
- Spill Impacts and Ecosystem Recovery.

Level 2 Priority:

- Navigation and Waterways Management;
- Vessel Design;
- Training and Readiness Evaluation;
- Oily / Oiled Waste Disposal;
- On-Water Containment and Recovery; and
- Basic Fate and Transport.

Level 3 Priority

- Personnel Health and Safety;
- Alternative On-Water Countermeasures;
- At-Source Containment and Countermeasures; and
- Vessel Damage Assessment and Salvage.

While pursuing R & D in these specific technology areas, there is a need to address several general issues, which will aid in achieving the desired advances in oil spill research and acting on the recommendations of the National Research Council's Marine Board. To carry out the program of field testing that the Marine Board determined to be a vital component of the federal plan, work must continue to develop streamlined permitting procedures and protocols for carrying out experimental oil spills in the environment and capitalizing on spills of opportunity. To bridge the gap from laboratory testing to full-scale field testing and use, mesoscale testing of spill response equipment is critical. The National Oil Spill Response Test Facility provides the research and response communities with unique capabilities in this regard and the Committee supports the facility's continued operation and maintenance by the MMS.

Another recommendation of the Marine Board dealt with public perception of and participation in the decision-making process. One method of addressing this is to recognize the importance of universities and non-profit institutions in finding solutions to oil spill problems, and to encourage the creation of regional centers of expertise. Federal cooperation with various stakeholders should continue with the aim of leveraging both knowledge and resources.

Finally, a great deal of work remains to analyze and model the oil spill system. Success in this area would result in an improved understanding of events leading to oil spills and what actions can be taken to minimize their occurrence. Improving the quality of oil spill data available for building this model, conducting risk analyses, and developing pollution prevention policies, remains a topic for continued interagency action.

Appendix A. Assessments and Forecasts for Oil Pollution Technology Areas

SPILL PREVENTION

Human Factors

Description of Technology: This technology area focuses on how human performance and human factors contribute to marine casualties and other accidents in the oil production/transportation system. It includes the development of advanced methods and systems for training vessel crew members, basic research on vessel crew performance in preventing oil spills (as through safe navigation and proper oil transfer practices), and the development of methods and technologies to evaluate crew members' ability and knowledge in performing their duties.

Importance: Conservatively, between 60 and 80 percent of accidents in marine transportation and related industries are attributed to "human errors". These errors can result from inadequate training, poor management, poor equipment maintenance, and problems in the interface between man and machine. Identifying and solving various human factors problems can significantly reduce oil spills at far less cost than more expensive technology-based solutions. *Potential impact is **high**.*

Current Development Status: Several research projects are being undertaken by the Coast Guard in the human factors area. The first project focuses on the impact of merchant marine operations and associated fatigue on crew performance. This involves collecting and analyzing data on merchant marine operations (length of tour, work schedule, and number of port stops and manning levels), and identifying practices which may predispose crew members to casualties. A second project looks at the impact of automation on crew performance. Efforts include measuring the mariner's understanding of automated equipment, and improving training to reduce the potential for error. A third project is investigating the impact of crew size on vessel safety. This includes development of models for simulating shipboard operations and estimating safe crew size.

Research is also underway to determine the human factors issues associated with Advanced Navigation and Waterways Management technologies, including Electronic Chart Display Information Systems (ECDIS) and Vessel Traffic Services (VTSs). A separate project is being conducted by the University of Miami under the OPA 90 Regional Grants Program to investigate the "human factors" contribution to oil transfers involving tank barges.

In addition, MARAD is undertaking cooperative research programs with industry to identify and address short-term and long-term research needs in human factors and vessel automation. These programs include the Ship Operations Cooperative Program (SOCA), which focuses on bridge layout and tasking, and the Vessel Pilots Cooperative Program, which is evaluating the use of a portable DGPS system in piloting operations. MARAD is also sponsoring a cooperative research program with the State and Federal maritime academies. Specific projects include development of a marine human factors bibliography, examination of the institutional awareness of regulatory changes, identification of operational trends into the 21st century, and a comparison of job training effectiveness and job satisfaction between male and female students. A Marine Board study is also underway on human performance, organizational systems, and maritime safety.

The Minerals Management Service has also initiated a joint industry project to consider human factors in oil well control. In addition they are sponsoring an international workshop titled "The Use of Human and Organizational Factors in the Management of Safety and Environmental Hazards for Offshore Operations" in December 1996.

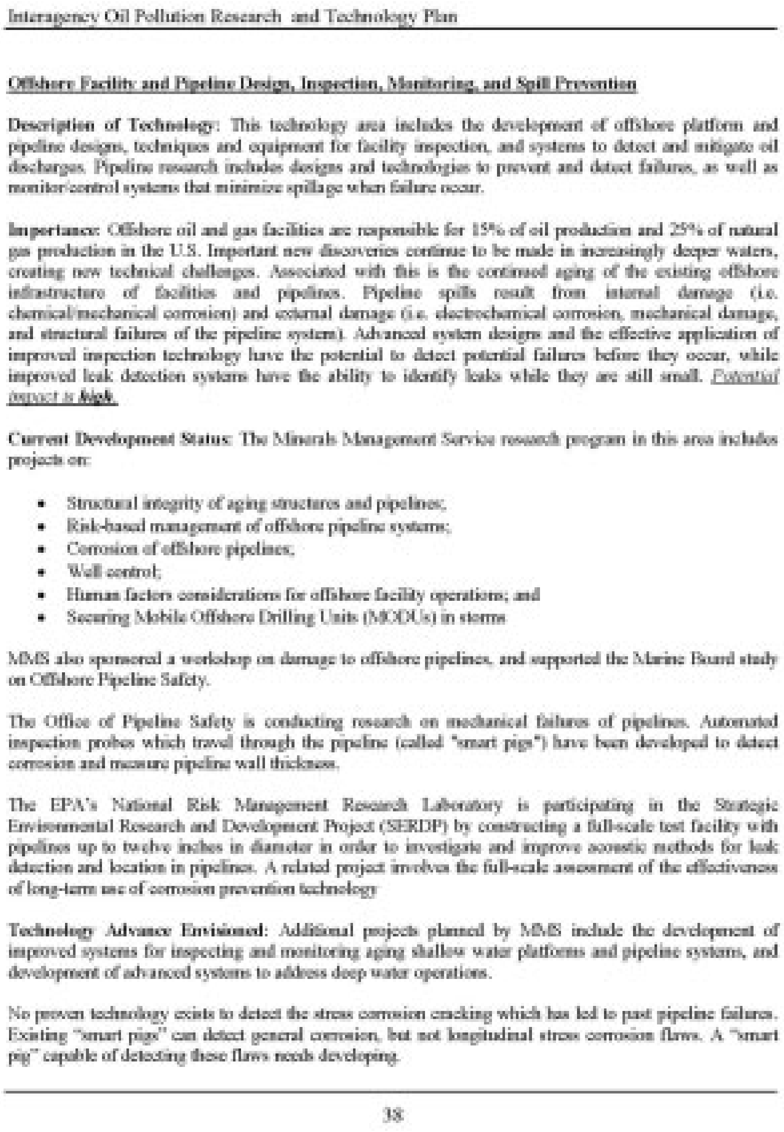
Technology Advance Envisioned: The impact of vessel automation and reduced manning on crew performance and vessel safety will cause a significant change in the knowledge, skills, and abilities required of mariners. As a result, additional research is necessary to determine the training requirements for crew members operating in this automated environment. Training methods and technologies (such as ship simulators) must be assessed to determine their utility in providing training. Training programs that focus on shipboard "team" performance vs. individual mariner performance should be investigated. Development of operational instrumentation and protocols for real-time fitness-for-duty testing could supplement the training efforts as crew fatigue and alertness are certain to be primary factors in safe operations.

Required Research Focus Areas:

- Training technologies for automated vessels
- The impact of automation on alertness
- Impacts of fatigue, sleep loss, and shift scheduling
- Instrumentation for real-time crew performance testing
- Team performance in shipboard situations
- Maritime organizational culture and its impact on crew performance

References:

- Sanquist, T. F., et al., 1995.
- Rothblum, A. M., et al., 1995.



Offshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention

Description of Technology: This technology area includes the development of offshore platform and pipeline designs, techniques and equipment for facility inspection, and systems to detect and mitigate oil discharges. Pipeline research includes designs and technologies to prevent and detect failures, as well as monitor/control systems that minimize spillage when failure occur.

Importance: Offshore oil and gas facilities are responsible for 15% of oil production and 25% of natural gas production in the U.S. Important new discoveries continue to be made in increasingly deeper waters, creating new technical challenges. Associated with this is the continued aging of the existing offshore infrastructure of facilities and pipelines. Pipeline spills result from internal damage (i.e. chemical/mechanical corrosion) and external damage (i.e. electrochemical corrosion, mechanical damage, and structural failures of the pipeline system). Advanced system designs and the effective application of improved inspection technology have the potential to detect potential failures before they occur, while improved leak detection systems have the ability to identify leaks while they are still small. *Potential impact is* ***high.***

Current Development Status: The Minerals Management Service research program in this area includes projects on:

- Structural integrity of aging structures and pipelines;
- Risk-based management of offshore pipeline systems;
- Corrosion of offshore pipelines;
- Well control;
- Human factors considerations for offshore facility operations; and
- Securing Mobile Offshore Drilling Units (MODUs) in storms

MMS also sponsored a workshop on damage to offshore pipelines, and supported the Marine Board study on Offshore Pipeline Safety.

The Office of Pipeline Safety is conducting research on mechanical failures of pipelines. Automated inspection probes which travel through the pipeline (called "smart pigs") have been developed to detect corrosion and measure pipeline wall thickness.

The EPA's National Risk Management Research Laboratory is participating in the Strategic Environmental Research and Development Project (SERDP) by constructing a full-scale test facility with pipelines up to twelve inches in diameter in order to investigate and improve acoustic methods for leak detection and location in pipelines. A related project involves the full-scale assessment of the effectiveness of long-term use of corrosion prevention technology

Technology Advance Envisioned: Additional projects planned by MMS include the development of improved systems for inspecting and monitoring aging shallow water platforms and pipeline systems, and development of advanced systems to address deep water operations.

No proven technology exists to detect the stress corrosion cracking which has led to past pipeline failures. Existing "smart pigs" can detect general corrosion, but not longitudinal stress corrosion flaws. A "smart pig" capable of detecting these flaws needs developing.

Required Research Focus Areas:

- Deep water, automated inspection and repair systems
- The role of hydrates in deep water failures
- Inspection techniques for flexible risers
- Improved leak detection systems for offshore pipelines
- The risk of ice-gouging in Arctic areas
- Well control technologies for deep water operations
- Inspection techniques for aging pipeline systems
- Stress corrosion cracking detection

References:

- Personal communication with Charles Smith, Minerals Management Service. September 15, 1995.
- Personal communication with Lloyd Ulrich, OPS. September 12, 1995.
- Science Advisory Board, 1994.

Onshore Facility and Pipeline Design, Inspection, Monitoring, and Spill Prevention

Description of Technology: This technology area includes the development of onshore facility and pipeline designs, techniques and equipment for facility inspections, and systems to detect and mitigate oil discharges. Pipeline research includes designs and technologies to prevent and detect failures, as well as monitor/control systems that minimize spillage when failure occur.

Importance: A significant number of discharges occur from onshore facilities in the coastal area. Approximately 20% of the volume of oil discharged is due to bunkering and cargo transfer. Storage tank leakage and failures add to this volume. An even greater portion of spills occur at facilities located further inland.

Storage tank and facility pipeline failures have resulted in major inland spills. Advanced system designs and the effective application of improved inspection technology have the potential to detect potential failures before they occur, while improved leak detection systems have the ability to identify leaks while they are still small. *Potential impact is **high***.

Current Development Status: Aside from pipeline research, only limited work has been done in this area since the passage of OPA 90. A small, Coast Guard-sponsored project is in progress at the University of Miami to look at the "human element" in oil transfers.

The Office of Pipeline Safety is conducting research on mechanical failures of pipelines. Automated inspection probes which travel through the pipeline (called "smart pigs") have been developed to detect corrosion and measure pipeline wall thickness.

The EPA's National Risk Management Laboratory is participating in the Strategic Environmental Research and Development Project (SERDP) by constructing a full-scale test facility with pipelines up to twelve inches in diameter in order to investigate and improve acoustic methods for leak detection and location in pipelines. A related project involves the full-scale assessment of the effectiveness of long-term use of corrosion prevention technology

Technology Advance Envisioned: Develop advanced systems for facility monitoring and spill detection. Continue human factors R&D to determine the role of human error in facility spills, and procedures and technologies for prevention.

No proven technology exists to detect the stress corrosion cracking which has led to past pipeline failures. Existing "smart pigs" can detect general corrosion, but not longitudinal stress corrosion flaws. A "smart pig" capable of detecting these flaws needs developing

Acoustic technologies can be refined to inspect pipelines effectively without passing a "pig" through the pipeline or excavating the pipe. This technology may be extendible to the detection and location of leaks in oil handling facility storage tanks.

Required Research Focus Areas:

- Facility monitoring and spill detection systems
- Stress corrosion cracking detection
- Acoustic leak detection and location

References:

- Personal communication with Lloyd Ulrich, OPS. September 12, 1995.
- Science Advisory Board, 1994.

Navigation and Waterways Management Systems

Description of Technology: This technology area includes methods, equipment, and integrated systems designed to improve navigation at sea and in ports, rivers, and inland waterways. It includes both navigation systems on-board the vessel, such as bridge expert systems and collision avoidance systems, and systems external to the vessel, such as vessel traffic systems and piloting systems. It also includes general research into navigation risks and the impact of navigation safety programs, as well as the development of decision support tools for waterways management efforts.

Importance: Most major spills from vessels are caused by a navigation-related marine casualty such as a collision or grounding. Improving navigation and waterways management, particularly in congested port areas and the approaches to ports, can prevent many of these accidents. *Potential impact is* ***moderate.***

Current Development Status: Substantial progress has been made in this area since OPA 90 through refinements in the Global Positioning System (GPS) and the development of Electronic Chart Display and Information Systems (ECDIS). GPS provides worldwide satellite positioning to an accuracy of 100 meters, and has been refined by the Coast Guard through the Differential GPS project to provide accuracy to within 10 meters. ECDIS provides the capability for continuously updating and displaying vessel position and other navigation information on an electronic chart. These two technologies can be integrated through use of Automated Dependent Surveillance to provide electronic chart navigation on the bridge, and a reliable, low-cost VTS in ports. Such an ADS/VTS was implemented and tested in Narragansett Bay as mandated by OPA 90. Other advances include using GPS and ECDIS for high-accuracy positioning of aids-to-navigation.

Advances in artificial intelligence and expert systems have led to the development of Shipboard Piloting Expert Systems (SPES) to assist mariners on the bridge in planning and conducting safe navigation, particularly in congested areas. These systems include a series of alerts to inform the mariner of situations of potential concern and upcoming decision points, as well as alarms to warn of imminent danger. This research began in 1989 and was conducted by MARAD and the Coast Guard in cooperation with industry. Follow-on research is being conducted under the OPA 90 Regional Grants Program through a project to design, develop, and evaluate a SPES on the St. Lawrence Seaway for both shipboard and VTS installation. Additional research (under the Smart Bridge project) is also underway with support from the ARPA MariTech program. This project incorporates sophisticated sensor fusion and real-time knowledge-base and database management capabilities, leveraged with significant combat and sensor system developments, for the development of an advanced SPES for San Francisco Bay.

In the area of waterways management, an effort has been initiated to develop a waterways management evaluation DSS to support risk assessment and resource allocation functions. The development of a ship transit model and waterways evaluation tools have already begun.

Technology Advance Envisioned: The development of risk assessment models and tools must be continued. The next significant technology advance in this area will be the development and testing of an integrated SPES and ECDIS system, incorporating advanced sensor fusion input and integration capabilities. These SPES can be integrated with both shipboard and vessel traffic systems to produce intelligent information sharing and decision-making. Further VTS efforts include development and testing of Automated Dependent Surveillance Systems (ADSS) for waterways management.

Required Research Focus Areas:

- Development of advanced SPES, including sensor fusion and integration
- Integration of SPES with VTS
- Advanced Automated Dependent Surveillance Systems
- Comprehensive Waterways Management DSS
- Human factors component of SPES, ECDIS, and ADSS

Vessel Design

Description of Technology: This technology area includes the development and testing of advanced tanker and barge designs to make vessels more resistant to damage and less likely to spill their cargoes into the sea.

Importance: Although single hull tankers and barges are highly susceptible to damage from collisions and groundings, tanker designs are currently available which can significantly reduce the outflow of oil. For example, the double-hull tanker design is being required for vessels entering U.S. ports under OPA 90, while the IMO has accepted both the double-hull and mid-deck tanker design. Additional research and development is needed to verify these approaches and investigate other measures to reduce tanker and barge damage. *Potential impact is* **moderate.**

Current Development Status: The Coast Guard completed an extensive study of tanker design alternatives as mandated by OPA 90. This included the National Academy of Science study and an independent evaluation by Herbert Engineering Corporation. These two studies form the basis of the USCG double-hull policy under OPA 90. Follow-on research is proceeding at Massachusetts Institute of Technology, which includes the development of an advanced computer model to predict damage to tankers, and a "Handbook of the Grounding Protection of Ships," which addresses both Structural Analysis and Welding. Research is also underway at the David Taylor Naval Ship Research and Development Center involving model testing of tanker designs in grounding situations. Finally, efforts are also proceeding to test the "American Underpressure System" which is designed to provide a spill reduction capability for single hulled vessels.

Technology Advance Envisioned: The development of advanced models for predicting tanker and barge damage, and evaluating alternative designs. Continued testing of alternative designs will also be maintained as they are introduced.

Required Research Focus Areas:

- Advanced model development
- Testing and evaluation of underpressure system

References:

- Husain, M., 1995.
- Herbert Engineering Corp., 1992.
- National Research Council, 1991

SPILL RESPONSE PLANNING, TRAINING, AND MANAGEMENT

Decision Support Systems for Contingency Planning and Response

Description of Technology: This technology area involves the development of computer-based systems which would provide information more rapidly and facilitate decision-making during contingency planning and response. Development generally includes the development and integration of databases, models, geographic information, mapping systems, and expert systems tailored to oil spill response needs.

Importance: Acquiring the necessary information to make correct decisions, and keeping track of the results of these decisions is a significant challenge for responders during a major spill event. Accurate and accessible technical and operations management information must be provided in the proper sequence and format to facilitate the process. Decision Support Systems (DSSs) can provide this information to support both contingency planning and response activities. In addition, DSSs provide continuity in the overall "knowledge base" of the spill response community. This offsets problems associated with the influx of new people into this area, and the high turnover of personnel. *Potential impact is* ***high.***

Current Development Status: Significant advances have been made in the past five years, including the development of specific databases containing information on response resources and capabilities, models to predict spill trajectory and behavior, guidance to evaluate countermeasures and cleanup options, and geographical information systems (GIS) and other mapping systems for interpretation and display of shoreline environmental data, sensitivity, the location of response resources, and appropriate deployment points. These components have been integrated into several complete DSS for use during contingency planning and response. USCG and NOAA have jointly developed the Spill Planning, Exercise and Response System (SPEARS), an integrated system of models, databases, and maps. The Coast Guard is evaluating functional characteristics of the Multi-Agency Response - Tactical Action Display System (MARTADS) for command post display of spill management information. These first-generation systems are being implemented by government agencies and industry, and are undergoing testing and refinement to improve operational support.

Technology Advance Envisioned: DSSs represent a powerful tool in improving oil spill response management. The next level in the development process is improving and expanding the databases and models to support the full range of contingency planning and response functions, and integrating these components using advanced expert systems and artificial intelligence technologies. The goal is to have a system that can evaluate the queries of the user, retrieve the most relevant information, and present the information in a sequence and format that enhances and accelerates decision-making, but does not mislead the user into false conclusions. In the longer term, such systems will automatically update their knowledge base through feedback on actual events, improving their utility over time and providing better data for use in simulator based training programs.

Required Research Focus Areas:
- Advanced DSS development
- Integration of DSSs into training programs
- Advanced user interface and presentation

References:
- Howlett, E., et al., 1995.

Spill Trajectory and Behavior Prediction

Description of Technology: This technology area involves the development and verification of numerical models to predict the movement of oil spills, the "weathering" (spreading, evaporation, dispersion, dissolution, and sinking) of spilled oil, and the resulting changes in the physical properties of the oil in different environments. It includes methodologies to provide accurate input data and verify model output.

Importance: Predicting the trajectory (movement) and the weathering of spilled oil, and its resultant physical properties, is critical to the mobilization and deployment of appropriate and adequate spill countermeasures. It is also important for developing risk assessments and contingency plans for spill response, and for evaluating potential environmental damage. *Potential impact is* ***high***.

Current Development Status: Oil spill trajectory models are highly advanced and capable of accurately predicting spill movement under a variety of conditions. Several fully tested and verified models are in use within government, academia, and the commercial sector to cover ocean, coastal, estuarine, and river applications. However, these are generally limited by the quantity and quality of local meteorological and oceanographic input data. Another problem is the lack of real-time data on spill size and movement (as provided by observations and remote sensing) for validating and fine tuning the models.

Many models are available for predicting oil spill behavior and physical properties. Significant advances have been made in the past five years in refining these models, and verifying the results against oil spill behavior and physical properties data observed in the laboratory and the field. In addition, trajectory and behavior models have been combined into composite models which predict and graphically display spill movement and status. These are readily available from government and commercial sources.

Technology Advance Envisioned: Trajectory models themselves represent a fully-developed technology with only incremental refinements necessary at this time. The next significant technology advance in this area will be linking these models with sources of real-time input data (e.g. meteorological and coastal oceanographic monitoring stations, and airborne and satellite remote sensing systems), and verifying data for the output of the models. Although models have been linked with specific data sources in the past, no development program exists to establish a fully integrated modeling and observation capability with established input and verification protocols. Protocols were recently published by NOAA for model output.

Behavior models are also highly developed for common oils and open ocean environments, but must be linked to a comprehensive database containing input parameters and comparison data derived from laboratory studies, field studies in specific geographical areas, and past spill experience. Models should also be able to accept data on measured oil properties during the spill to verify results and adjust key parameters. The only areas where fundamental research and model development are required is in predicting the transport and sinking of heavier oil products (Low API Specific Gravity Oils - LAPIO) and shoreline transport and behavior for different beach types.

Required Research Focus Areas:

- Trajectory model input and verification
- Behavior model/database integration
- Model development for heavy oils
- Regionalize models by developing region specific parameters and input data

References:

- Galt, J. A., 1995.
- Spaulding, M., 1995.
- Michel, J., et al., 1995.

Training and Readiness Evaluation

Description of Technology: This technology area focuses on the development of oil spill simulators and computer-assisted tools to train personnel in oil spill response, and evaluate their knowledge and decision-making skills in a simulator setting, and during field exercises under the U.S. Coast Guard's Preparedness for Response Exercise Program (PREP).

Importance: Effective response requires that personnel be well-versed in the management doctrine and technical issues surrounding oil spill response. It also requires that personnel be able to translate this knowledge into effective decision-making during the spill, and be able to interact with other spill response participants. As major spills are infrequent events, it is difficult to maintain and verify this proficiency over time. Maintaining and evaluating this proficiency is a mandate of OPA 90 and the National Contingency Plan. Simulators and other technology based training and evaluation tools provide a cost-effective means of building, maintaining and evaluating this knowledge and proficiency. *Potential impact is* **moderate.**

Current Status: The past five years have seen the rapid development, testing and operational implementation of oil spill response training simulators in key regional locations. This technology advance was enabled by previous development of computer-assisted training simulators for other missions (e.g. aviation, vessel navigation). With funding support from the U.S. Coast Guard, simulator development is proceeding at Massachusetts Maritime Academy, Texas A&M University, and New York Maritime Academy at Fort Schuyler. These simulators focus on developing tactical command and control decision-making during large spills. In addition, the Coast Guard is developing the methodology and technology to support the "annual response area management team exercises" under the PREP. To date, two systems are in various stages of development - the Multi-Agency Advanced Team-Building Enhancement System (MATES) and the Pollution Incident Simulation, Control and Evaluation System (PISCES). Research is underway to determine if the regional simulators can be adapted for readiness evaluation activities under the PREP. This should reduce the need for full-scale field exercises, and greatly decrease the cost of the PREP.

Technology Advance Envisioned: Simulator-based training and readiness evaluation programs have focused on command and control decision-making for major spills in a specific port area. The scenarios involve executing the response activities outlined in the Area Contingency Plans. There is a need to develop a training and evaluation program that will improve and evaluate readiness for Spills of National Significance (SONS) which can cover large geographic areas and involve numerous agencies and organizations. The next step is development of a SONS Command Post simulator, which exercises strategic decision-making at a higher level. The development process will include implementation and testing at the regional maritime academies currently providing simulator-based training.

Required Research Focus Areas:

- Develop, test and evaluate a SONS Simulator

References:

- Barry, D., et al., 1995.

Personnel Health and Safety

Description of Technology: This technology area includes studies on the effects of spilled oil and oil spill cleanup on personnel health and safety, and the development of monitoring instruments and protective equipment to protect personnel engaged in cleanup operations.

Importance: Oil is a hazardous substance. Hazards in dealing with crude oil include fire and explosion, vapor toxicity, and danger from dermal exposure. In particular, benzene vapors present a major concern. Certain cleanup techniques such as dispersant application, in situ burning, and bioremediation also present hazards. These hazards are added to the inherent dangers of carrying out operations at sea. It is a fundamental responsibility of the On-Scene Coordinator and other response supervisors to safeguard the health and safety of cleanup personnel. To date, there have been no long-term epidemiological studies that can provide comprehensive guidance for worker health and safety under a range of spill conditions. *Potential impact is* **low.**

Current Development Status: The topic of worker health and safety was addressed in a workshop organized by MSRC in January of 1993. The Coast Guard also conducted a study entitled "Condensed USCG Oil Spill Response Health and Safety Plans, which identified health and safety issues associated with oil spill response in order to develop information and protocols for use by response personnel. From these reports five priority topics for additional research were identified. These included:

- Procedures for spill site assessment and characterization
- Current field instruments for monitoring benzene
- Chemical composition of fresh and weathered crude oils
- Guidelines for decontamination and dermal exposure assessments
- Sponsor and support an industrial hygiene panel for spill response.

Another MSRC study reviewed the current literature and developed research needs focusing on the implications of crude oil exposure. In addition, ongoing research since OPA 90 has examined the levels of benzene encountered during spill cleanup and analyzed the health and safety implications of exposure.

Technology Advance Envisioned: Additional research is needed on the inhalation and dermal exposure hazards of crude oils, hydrocarbon mixtures, and hydrocarbon aerosols. Site safety assessment procedures and monitoring protocols should be standardized, and the necessary monitoring instrumentation specified, with additional application-specific instrumentation developed as needed. Protective clothing and equipment adequacy should also be assessed to determine additional technology needs. Finally, information on toxicity, site safety assessment procedures, monitoring protocols and instrumentation, and personal protection should be compiled into a comprehensive database for access during spill response.

Required Research Focus Areas:

- Toxicity of crude oils/hydrocarbons
- Health and safety protocols and technology
- Health and safety database

References:

- Science and Policy Associates, Inc., 1993.
- Holliday, M. G., and J. M. Park, 1993.

SPILL COUNTERMEASURES AND CLEANUP

Dispersants

Description of Technology: Dispersants are a specific type of oil spill chemical countermeasure which reduces oil/water interfacial tension so that the oil can disperse in small droplets into the water column. Development areas include increasing dispersant effectiveness, reducing the environmental effects of the chemicals themselves, developing vessel and aircraft application methodologies and equipment, and studying the distribution and impact of the chemicals and dispersed oil in the environment. An important supporting activity is the development of an information base on dispersant product effectiveness, application procedures, and effects.

Importance: Dispersants are an important tool in spill response when it is critical to prevent oil from reaching a sensitive resource (such as a coral reef, marsh area, or wildlife sanctuary). These situations justify the intentional dispersion into the water column as a tradeoff to prevent greater impact to the protected resource. Even though their use is pre-approved in various Area Contingency Plans, so much controversy surrounds dispersant use in the U.S. that they are seldom used. However, with refinements in dispersant formulations to improve their effectiveness and reduce environmental effects, and with the general acceptance of their use in other countries, dispersants remain a viable option to U.S. responders. *Potential impact is* ***high.***

Current Status of Development: Since the EXXON VALDEZ spill, the development of dispersant technology has continued at a modest but steady pace. New dispersant formulations have been developed by government researchers (particularly Environment Canada with support from MMS), and industry (particularly Exxon). In addition, aircraft application procedures have been refined and field tested in a joint project between the U.S. Air Force, MSRC, and Texas General Land Office. Meanwhile, testing protocols have been refined and data recorded in the National Contingency Plan Products Schedule and a Chemical Countermeasures database developed by the Coast Guard and NOAA. A dispersants application calculator has also been developed by NOAA and USCG and integrated into the SPEARS decision support system. In summary, dispersant technology is a fully operational tool with additional research to be directed at refining the technique and gaining broader acceptance by the response community.

Technology Advance Envisioned: An ongoing program of field testing is required to refine application procedures and study the effects and effectiveness of this technology. These results will facilitate acceptance of dispersants. In addition, an ongoing program should be established to compile operational and technical data on dispersants, and update the dispersants database for use in decision support systems.

Required Research Focus Areas:

- Dispersant technology testing and evaluation
- Dispersant database update

References:

- Fingas, M., et al., 1995.
- LaBelle, R., and E. Danenberger, 1995.
- Goodman, R., 1995.

In situ Burning

Description of Technology: *In situ* burn technology includes the techniques and equipment required to ignite and sustain combustion of oil spills on the water and along shorelines. It includes development of equipment, such as fire resistant booms and ignition devices, and of a knowledge base containing both the conditions under which the technique can be effectively applied, and the impact of the use of such technique on the environment, including both human health and ecological considerations.

Importance: *In situ* burning is the most promising technique for removing large amounts of oil from the surface of the water as encountered during major and catastrophic spills. It can also be an effective method of mitigating spills on land and in coastal areas. *Potential impact is* **high**.

Current Development Status: The concepts, methodologies, and basic equipment for *in situ* burning were developed prior to the EXXON VALDEZ spill. During the past six years, an extensive test and evaluation effort was undertaken by government (both U.S. and Canadian) and private industry to demonstrate the technology, and document its effectiveness and effects under operational conditions at sea. One experiment, conducted off Newfoundland in August 1993, was successful in demonstrating operational feasibility and documenting the acceptability of the associated air and water contamination. Supporting research included laboratory and mesoscale studies of the effectiveness and contamination levels as a function of oil type and thickness, the impact of oil emulsification, and the utility of smoke reducing agents. Prototype air contamination monitoring equipment was developed and tested. Several smoke plume and dispersion models have been developed. Refinements have also been made to fire-resistant boom designs, with several designs now commercially available. However, problems still remain with boom durability for multiple burns, and the sea-keeping ability of fire-resistant booms in seas greater than 3 feet.

In situ burning is also being seriously considered for oil spills on wetlands (I.A. Mendelsohn of Louisiana State University), and on dry land (EPA) under certain conditions.

Technology Advance Envisioned: *In situ* burning has reached the operational implementation stage, and is being incorporated into Area Contingency Plans. The technology has a broad range of offshore, coastal, and inland applications.

Fire-resistant booms are being developed by the commercial sector which incorporate advanced materials to improve boom durability and handling. Government efforts should focus on developing a protocol for testing these designs, and encouraging and supporting further industry efforts, specifically keeping in mind that fire-resistant booms are needed which will operate in greater sea states.

In addition to equipment development, a knowledge base must be created of the spill conditions (primarily oil physical properties) and environmental parameters (e.g., wind, wave, type of vegetation, season, downwind land use, etc.) under which the technique is viable. This knowledge base will be developed through further mesoscale testing and data collection at actual spills (both experimental spills and spills-of-opportunity).

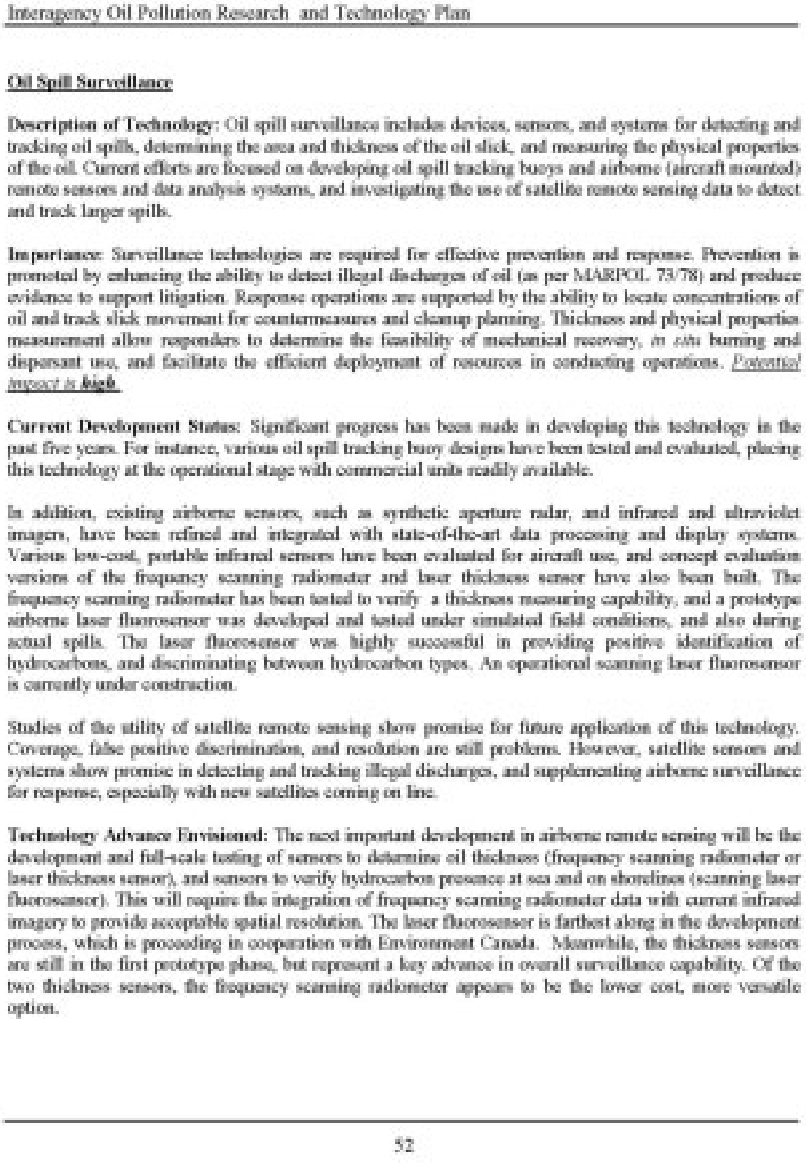
In situ burning can present hazards to the health of personnel carrying out the operation, as well as populations downwind. Additional research is needed to fully document these hazards. Improved monitoring protocols and equipment are also needed to ensure these hazards are minimized.

Required Research Focus Areas:

- Fire-resistant boom protocol and testing
- Fire-resistant boom development
- Simplified air plume models
- *In situ* burn knowledge base
- Health and safety protocols and monitoring
- Emulsion breaking and soot suppression techniques
- Effects of burning on soils and wetlands and guidelines for use of this remediation tool

References:

- Fingas, M., et al., 1995.



Oil Spill Surveillance

Description of Technology: Oil spill surveillance includes devices, sensors, and systems for detecting and tracking oil spills, determining the area and thickness of the oil slick, and measuring the physical properties of the oil. Current efforts are focused on developing oil spill tracking buoys and airborne (aircraft mounted) remote sensors and data analysis systems, and investigating the use of satellite remote sensing data to detect and track larger spills.

Importance: Surveillance technologies are required for effective prevention and response. Prevention is promoted by enhancing the ability to detect illegal discharges of oil (as per MARPOL 73/78) and produce evidence to support litigation. Response operations are supported by the ability to locate concentrations of oil and track slick movement for countermeasures and cleanup planning. Thickness and physical properties measurement allow responders to determine the feasibility of mechanical recovery, *in situ* burning and dispersant use, and facilitate the efficient deployment of resources in conducting operations. *Potential impact is* ***high***.

Current Development Status: Significant progress has been made in developing this technology in the past five years. For instance, various oil spill tracking buoy designs have been tested and evaluated, placing this technology at the operational stage with commercial units readily available.

In addition, existing airborne sensors, such as synthetic aperture radar, and infrared and ultraviolet imagers, have been refined and integrated with state-of-the-art data processing and display systems. Various low-cost, portable infrared sensors have been evaluated for aircraft use, and concept evaluation versions of the frequency scanning radiometer and laser thickness sensor have also been built. The frequency scanning radiometer has been tested to verify a thickness measuring capability, and a prototype airborne laser fluorosensor was developed and tested under simulated field conditions, and also during actual spills. The laser fluorosensor was highly successful in providing positive identification of hydrocarbons, and discriminating between hydrocarbon types. An operational scanning laser fluorosensor is currently under construction.

Studies of the utility of satellite remote sensing show promise for future application of this technology. Coverage, false positive discrimination, and resolution are still problems. However, satellite sensors and systems show promise in detecting and tracking illegal discharges, and supplementing airborne surveillance for response, especially with new satellites coming on line.

Technology Advance Envisioned: The next important development in airborne remote sensing will be the development and full-scale testing of sensors to determine oil thickness (frequency scanning radiometer or laser thickness sensor), and sensors to verify hydrocarbon presence at sea and on shorelines (scanning laser fluorosensor). This will require the integration of frequency scanning radiometer data with current infrared imagery to provide acceptable spatial resolution. The laser fluorosensor is farthest along in the development process, which is proceeding in cooperation with Environment Canada. Meanwhile, the thickness sensors are still in the first prototype phase, but represent a key advance in overall surveillance capability. Of the two thickness sensors, the frequency scanning radiometer appears to be the lower cost, more versatile option.

Required Research Focus Areas:

- Advanced sensor integration and data analysis techniques
- Laser fluorosensor refinement and testing
- Frequency scanning radiometer development

References:

- Engelhardt, F., 1995.
- Goodman, R., 1995.
- Hover, G., 1995.
- LaBelle R., and E. Danenberger, 1995

Shoreline Countermeasures and Cleanup

Description of Technology: This technology area covers methods, treating agents, and equipment for removing oil from shorelines and mitigating the environmental impact of oil that cannot be removed. Specifically, it includes water washing and flooding techniques, the use of chemical treating agents, mechanical removal, processing, and disposal of oiled material, and bioremediation.

Importance: Most major oil spills in coastal waters result in the oiling of the shoreline. This includes oiling of natural resources (e.g. beaches, marshes, coral reefs, mangroves), and man-made structures (e.g. breakwaters, seawalls, piers, and vessels). Removing or mitigating the impacts of the oil requires a range of technologies that are effective (remove/mitigate while minimizing environmental damage from the technology) and efficient (cost of the technology is reasonable). Implementing technologies also requires knowing the relative benefits of foregoing cleanup activities and allowing natural processes to remove the oil. *Potential impact is* ***high.***

Current Development Status: Although few new concepts have been developed, significant progress has been made in refining the state-of-the-art since the EXXON VALDEZ spill. For instance, a new laboratory surface washing agent effectiveness screening test is under development (EPA), chemical treating agents (e.g. surfactants) have been reformulated and tested on actual spills and in the lab, bioremediation application procedures and monitoring protocols have been improved and documented, and bioremediation effectiveness has been studied extensively by government (EPA and NOAA) and industry (MSRC and EXXON), often under joint projects. In addition, several updated shoreline assessment and cleanup manuals have been developed to provide technical guidance to responders, and several research efforts have focused on the question of cleanup vs. natural recovery, providing additional insight on when shoreline cleanup should be initiated, to what extent it should be pursued, and when it should be terminated.

Technology Advance Envisioned: Technologies developed to date are generally effective in removing oil from the upper surface and near surface layers of shoreline. As experienced after the EXXON VALDEZ spill, no effective method currently exists for removing sub-surface oil, short of physical removal, followed by cleaning or disposal. Technologies should be investigated for removing and mitigating the impacts of sub-surface oil. There is also a need to examine the results of combined physical, biological, and chemical methods, and to develop protocols for more effective application.

In addition to developing new technologies, additional research is required to fully understand the effectiveness and efficiency of currently available techniques. This research should proceed in the laboratory, at facilities such as the Coastal Oil Spill Simulation System (developed by the Texas General Land Office and Texas Water Commission, the Marine Spill Response Corporation, and Texas A&M University), and in the field, through planned experiments and documentation of results at actual spills, with the results of this research documented in a comprehensive database. Research is also needed to define the mechanisms and rates for shoreline self-cleaning, particularly through the interaction of the oil with fine mineral particles.

Required Research Focus Areas:

- Detailed protocols for each clean up technique for oil removal from shorelines
- Removal of subsurface oil
- Guidelines for sequential shoreline cleanup using multiple techniques
- Mechanisms and effectiveness of shoreline self-cleaning

- Validation of new surface washing agent effectiveness test protocol

References:

- Scott, R., 1993.
- Owens, E., and B. Humphrey, 1995.
- Venosa et al., 1996.

Oily / Oiled Waste Disposal

Description of Technology: This technology area includes procedures and equipment to dispose of oil and oiled debris recovered during spill cleanup. Specific technologies include solidification and stabilization prior to landfill disposal or recycling, oil reclamation, incineration, and biological treatment (such as land farming and composting).

Importance: Disposal of oil and oiled debris can be a severe problem during major spills, particularly in remote areas. Large quantities of waste may be collected in a very short time, and the types of waste are extremely variable in physical and chemical characteristics. In addition, the waste often generates public interest and media attention. In the past, much of this waste was disposed of in landfills. However, as this waste often qualifies as a hazardous material, and hazardous materials regulations are becoming more strict, landfill disposal is becoming less of an option. *Potential impact is* ***moderate.***

Current Development Status: Activity in this area has been limited since OPA 90. The Coast Guard developed an oil flaring device to incinerate oil in remote locations in the mid 1980s, and Environment Canada developed incinerators capable of disposing of oiled debris and cleaning shoreline material. In addition, land farming techniques have been developed by the oil industry to clean up contaminated storage and production sites.

Technology Advance Envisioned: Better technologies for segregating hazardous from non-hazardous oily waste will facilitate disposal. Meanwhile, stabilization and solidification techniques may render waste non-hazardous and suitable for disposal in landfills, and advanced mobile incinerators could eliminate the need for oil and waste transport, and be particularly useful in remote regions. Selection criteria and guidelines should be developed for expanded use of land farming, and additional biological methods investigated.

Required Research Focus Areas:
- Solidification and stabilization techniques
- Advanced mobile incinerators
- Criteria and guidelines for land farming
- Advanced biological treatment methods

References:
- McDonagh, M., et al., 1995.

On-Water Containment and Recovery

Description of Technology: This technology area includes the development of methods, equipment, and materials for physically containing and removing oil from the surface of the water, the water column, or the bottom. Equipment to support this technique includes booms, skimmers, oil/water separators, temporary storage devices, and sorbent materials.

Importance: Mechanical containment and recovery is often the only viable response option since it is not subject to pre-approval constraints (as are dispersant use and in situ burning). On-water recovery effectiveness for larger spills (total recovery is on the order of 20% of the oil spilled) is limited by the cleanup equipment's speed of advance and by sea conditions. Specifically, containment booms and many of the skimmers in use are limited to speeds of one knot or less and sea heights of three feet or less. However, since the cost of on-water recovery is an order of magnitude less expensive than shoreline cleanup, improvements in speed of advance and seakeeping capabilities of mechanical systems would significantly decrease the overall costs of oil spills. *Potential impact is* ***moderate.***

Current Development Status: Boom and skimmer designs have been developed and tested within the limitations outlined above. Much of this testing was conducted at the National Oil Spill Response Test Facility using different oils and realistic environmental conditions. In addition, new boom and skimmer designs are being built and tested to expand the capability to contain and recover oil in fast currents and heavier seas. Two Coast Guard grant projects are focused on this area. The University of Rhode Island is numerically modeling oil/water/boom systems, and the University of New Hampshire is modeling varied boom configurations. Both of these university efforts should lead to improvements in boom design. Although this area poses difficult challenges, progress is being made, and the resulting advances should yield improvements in overall mechanical recovery efficiency.

Significant advances have also been made in developing supporting equipment, particularly oil/water separators and temporary storage devices. These devices are critical to the overall mechanical recovery system, which requires removing oil from the water, followed by transport to shore, and proper disposal. An aggressive oil/water separator testing and development program undertaken as a joint government/industry project has produced several compact, lightweight oil/water separator prototypes capable of handling up to 250 gallons per minute. In addition, a second generation of temporary storage devices has been produced through industry development efforts supported by government test and evaluation, which incorporate modern materials and advanced designs. These designs are commercially available and have been added to equipment inventories.

Another advance has involved the integration of various boom, skimmer, and support equipment refinements into a second generation of vessel-of-opportunity skimming systems (VOSS). These systems allow vessels designed primarily for other purposes (buoy tenders, offshore supply vessels, and fishing vessels) to be converted quickly to oil spill response vessels. Several systems have been assembled and tested, and are available in the national spill response inventory.

Only minor refinements have been made in sorbent materials and booms. The major accomplishment in sorbents has been the development of a comprehensive sorbents testing protocol and database under a joint US/Canadian project. In addition, efforts are underway through ASTM to develop protocols for testing mechanical recovery equipment.

Unresolved problems involve the development of techniques to recover submerged oils and orimulsions. Recovery strategies for submerged oils (which may drift at mid-depth in the water column or sink to the bottom) are limited to blind "trawling" or dredging in the spill area. Technology for detecting or tracking subsurface oils are needed to accurately guide mechanical recovery efforts. Orimulsions (which may behave as a submerged oil or disperse rapidly in the water column) present unique challenges to recovery efforts. Until the behavior of this inexpensive fuel in the water column is understood and recovery methods developed, permits for its import will remain scarce.

Technology Advance Envisioned: Four major development efforts should be pursued in this area. The first is an ongoing effort to develop and test high seas and high current boom and skimmer designs. Present work indicates that while recovery capability in currents up to three knots has been achieved, containment (in contrast to diversion) with conventional booms in currents much above one knot is extremely difficult outside a test facility. Further research has the potential to achieve a doubling of the present capability in each area. The second effort is development and full-scale testing of a compact, lightweight oil water separator design in the lab and at-sea, with a maximum capacity of 250 gpm. As with the initial development of the first generation prototypes, this could be undertaken as a joint government/industry effort. The third area is fundamental development and testing of technologies for recovering submerged oils. Experience in past major spills indicates that this can be accomplished by adapting technologies used for other purposes (e.g. surface recovery, salvage, hazardous materials remediation, *and* mineral extraction). The fourth area is the development of recovery systems (consisting of skimming and containment/diversionary technology) for rivers and tidal areas with currents above three knots. For many important areas, conditions are beyond the capability of existing equipment. In addition, sweeping oil at less than 1.5 knots inhibits ship handling, resulting in low coverage factors. Increasing the sweep speed will significantly increase cleanup efficiency, reducing both cleanup costs and environmental impacts of oil spills.

Required Research Focus Areas:

- Fast water boom and skimmer development
- Oil/water separator development
- Submerged oil recovery technology
- Orimulsion recovery technology

References:

- Bitting, K., and A. Nordvik, 1995.
- Michel, J., et al., 1995.

Alternative On-Water Countermeasures

Description of Technology: This technology area includes the development of various chemicals used to treat oil slicks on the surface of the water by concentrating the oil and making it more amenable to other techniques, such as mechanical recovery and *in situ* burning. These chemicals include herding agents, solidifiers, elasticity modifiers, and emulsion treating agents. Emulsion breakers can also be used on recovered oil to decrease the amount of material for disposal. Development activities include improving chemical formulations, refining application techniques, and conducting studies of effectiveness and environmental effects.

Importance: These chemicals are not frequently used, but in certain cases can be very effective in improving oil recovery and oil impact mitigation. Because of the logistics involved in transporting and applying the chemicals on-scene, they are usually employed on smaller spills close to shore. Their use for larger spills is limited. *Potential impact is* **low.**

Current Development Status: Although these chemicals have been under development since the 1970s, efforts since the EXXON VALDEZ spill have been modest, and undertaken primarily by the commercial sector. MSRC conducted a detailed study of the state-of-the-art for such products, looking at the physical and chemical processes involved, application and recovery technologies, effectiveness determination, and environmental fate and toxicity. Their study concluded that additional research and development for herders, solidifiers and elasticity modifiers was unwarranted. Additional testing of emulsion treating agents was recommended to determine optimum injection point, refine application procedures, and document effectiveness and toxicity. Emulsion breakers are an important tool in spill response, as emulsions drastically decrease the effectiveness of mechanical recovery, *in situ* burning, and dispersant application. The report also recommended that information on effectiveness and effects be captured during actual use in the field, and compiled in a database for future reference.

Technology Advance Envisioned: The only additional research and development effort envisioned is establishment of a testing and evaluation program (including protocol development, laboratory testing, and field testing) for emulsion treating agents.

Required Research Focus Areas:

- Emulsion treating agents test and evaluation

References:

- Michel, J., et al., 1995.

At-Source Containment and Countermeasures

Description of Technology: This technology area includes the development of methods and equipment for mitigating oil flow from a vessel once the spill has begun, and for containing and recovering the oil at the source without substantial outside support. Such technologies include vacuum systems to reduce oil flow from tanks, automatic on-board oil transfer systems to remove oil from the damaged tank, rapid lightering systems to transfer the oil to another vessel, patching and plugging systems, booms and skimmers deployed from the vessel, and on-board dispersant application systems. Vessel destruction techniques are also included in this area.

Importance: The logistic difficulties, enormous costs, and limited success experienced during on-water and shoreline cleanup operations make clear the advantages of keeping oil within, or at least near the source. Despite the lack of past technological breakthroughs, advances in this area could provide substantial return on the R&D investment. *Potential impact low.*

Current Status of Technology Development: Although substantial effort has been devoted to this area in the past, progress has been minimal in operational prototype development, testing, and implementation. The most beneficial advance to date has been development of the Coast Guard Air Deployable Anti-Pollution Transfer System (ADAPTS) which is used routinely to offload oil from damaged tankers and barges. Follow-on research has been conducted at the Coast Guard R&D Center to investigate the potential for using advanced composites in transfer pumps, and other equipment to enhance performance, improve reliability, and extend service life.

An in-depth review of various tanker self-help countermeasures was conducted as a joint project between the U.S. government (Coast Guard) and Canadian government (Environment Canada and Transport Canada), with participation from private industry. This review indicated that passive countermeasures, such as rapid transfer from damaged tanks to designated storage tanks, were the most viable alternative. Active countermeasures such as deployment of booms and skimmers from the vessel were not recommended due to crew manning, logistics, and safety considerations.

Technology Advance Envisioned: Future development should focus on the refinement, laboratory testing, and full-scale testing of passive countermeasures, such as the rapid transfer systems and onboard systems for plugging penetrations of the vessel's hull. These systems should be integrated into the double-hull design mandated by OPA 90.

Required Research Focus Areas:

- Develop and test passive tanker on-board countermeasures

References:

- Battelle Memorial Institute, 1992.
- Gallagher, J., 1995.

Vessel Damage Assessment and Salvage

Description of Technology: This technology area includes the development of methodologies and equipment to assess the extent of damage to a stricken vessel (caused by collision, grounding, or explosion), and implement measures that will stabilize the vessel's condition, reduce the potential for further pollution, and allow it to be moved safely for repairs or disposal.

Importance: A critical consideration in responding to a vessel casualty is stabilizing the condition of the vessel to prevent loss of life, minimize loss of property, and prevent or minimize the spillage of oil. To accomplish this, on-scene personnel must rapidly assess the overall structural integrity and hydrodynamic stability of the vessel to determine the appropriate response measure. *Potential impact is* ***low.***

Current Status of Technology Development: Development efforts in this area have focused in two areas. The first is the development of computer programs to rapidly compute structural integrity and hydrodynamic stability. The second is the development of technologies to rapidly detect structural damage (particularly below the waterline), and determine the extent of flooding and oil loss.

Several damage and stability assessment programs were developed prior to OPA 90 and have since been refined and made readily available. As a result, further development in this area is not critical to effective response. Instead, efforts since OPA 90 have focused on the second area, including the development of remote sensors and underwater vehicles for surveying underwater damage. The Coast Guard completed a study of these tools in 1993 and found that a hull-crawling, remotely operated vehicle (ROV) would meet Coast Guard mission requirements. Based on this finding, the Coast Guard provided functional specifications for such a system.

Additional efforts have focused on determining damage and flooding from aboard the ship. Some of the methods and equipment developed for this purpose can be applied to routine marine inspection activities to check structural integrity, and, hence, prevent spills.

Technology Advance Envisioned: Functional prototype ROV for oil spill response.

Required Research Focus Areas:

- ROV system for vessel damage assessment

References:

- Battelle Memorial Institute, 1993.

FATE, TRANSPORT AND EFFECTS, MONITORING AND RESTORATION

Restoration Methods and Technologies

Description of Technology: This technology area includes methods and technologies to facilitate and accelerate the recovery of resources impacted by oil.

Importance: Restoration activities are mandated by OPA 90, which specifically requires that funds obtained through damage assessment and compensation litigation be expended on actual restoration activities. However, very few proven methods, technologies, or monitoring protocols exist to support such efforts. *Potential impact is* **high.**

Current Development Status: This technology area is in the formative stages, because there have been few efforts to actively restore habitats after oil spills. While methods for restoring certain habitats (e.g., salt marshes and sea grass meadows) exist, most have not been rigorously tested under varying environmental conditions. For other habitats (e.g. coral reefs, and inter-tidal and sub-tidal substrates), only limited methodology exists. Consequently, many restoration actions are viewed with skepticism. The development of indicators of habitat/living marine resource impact and recovery is critical for managers judging the "health" of an impacted ecosystem and the need for corrective action.

Habitat restoration is being addressed in a broader sense by the National Marine Fisheries Service, which outlined a research strategy focusing on five areas: ecosystem structure and function; effects of alterations; development of restoration methods; development of indicators of impact and recovery; and information synthesis and distribution. The Army Corps of Engineers is also investigating how restoration and remediation are addressed in spill contingency plans for the Gulf of Mexico.

Technology Advance Envisioned: The highest priority research areas for habitat restoration are development of actual restoration methods and defining indicators of habitat impact and recovery. General restoration research topics include: further development of bioremediation; experiments on species transplant as a viable technique for habitat restoration; the evaluation of the role and size of buffers; and the importance of habitat heterogeneity in the restoration process. The methods of research for development of restoration indicators will include comparative research on the structure and function of disturbed, natural, and/or restored habitats of different ages and geographical locations for a suite of biological, chemical, and physical parameters; time-dependent biotic population analyses; and contaminant level follow-up evaluation for sediment, biota, and water. This research will be conducted both on a laboratory-scale and at actual spill sites. Finally, data on restoration technologies and monitoring protocols would be collected in a national database.

Required Research Focus Areas:

- Technology-based restoration techniques
- Species transplant techniques
- The role of buffers and habitat heterogeneity
- Restoration indicators and measures of effectiveness
- Restoration spill-of-opportunity research program
- Restoration database

Spill Impacts and Ecosystem Recovery

Description of Technology: This technology area includes basic laboratory research, field studies, and modeling efforts to better understand and predict the long-term impacts of oil spills at the ecosystem level. This impact includes the impact of both the oil itself, and the countermeasures and cleanup techniques used to remove the oil. It also includes basic research, field monitoring activities, and modeling to determine the rate of ecosystem recovery both with and without countermeasures and cleanup.

Importance: This research provides important feedback on the effectiveness of past efforts, forms the basis for future decision-making during spill response, and provides input for damage assessment and restoration planning. *Potential impact is* ***high.***

Current Development Status: Several recent research efforts have focused on longer-term impacts and recovery of ecosystems, and how this recovery is facilitated or hindered by countermeasures and cleanup activities, particularly shoreline cleanup operations. This includes the extensive research effort in Prince William Sound to document the impacts of the EXXON VALDEZ spill and cleanup effort, research carried out subsequent to the Persian Gulf oil spill during Operation Desert Storm, and a comprehensive study completed in the United Kingdom to review and document the impact of spills and recovery of shorelines over the past three decades. These efforts and similar research both in the laboratory and the field indicate that knowledge and understanding of ecosystem impacts and recovery is limited, and that much of the information available on the topic is incomplete, anecdotal, and not comparable. In particular, available data is inadequate to permit discrimination between the impacts of the oil, and the impacts of countermeasures and cleanup techniques to remove the oil.

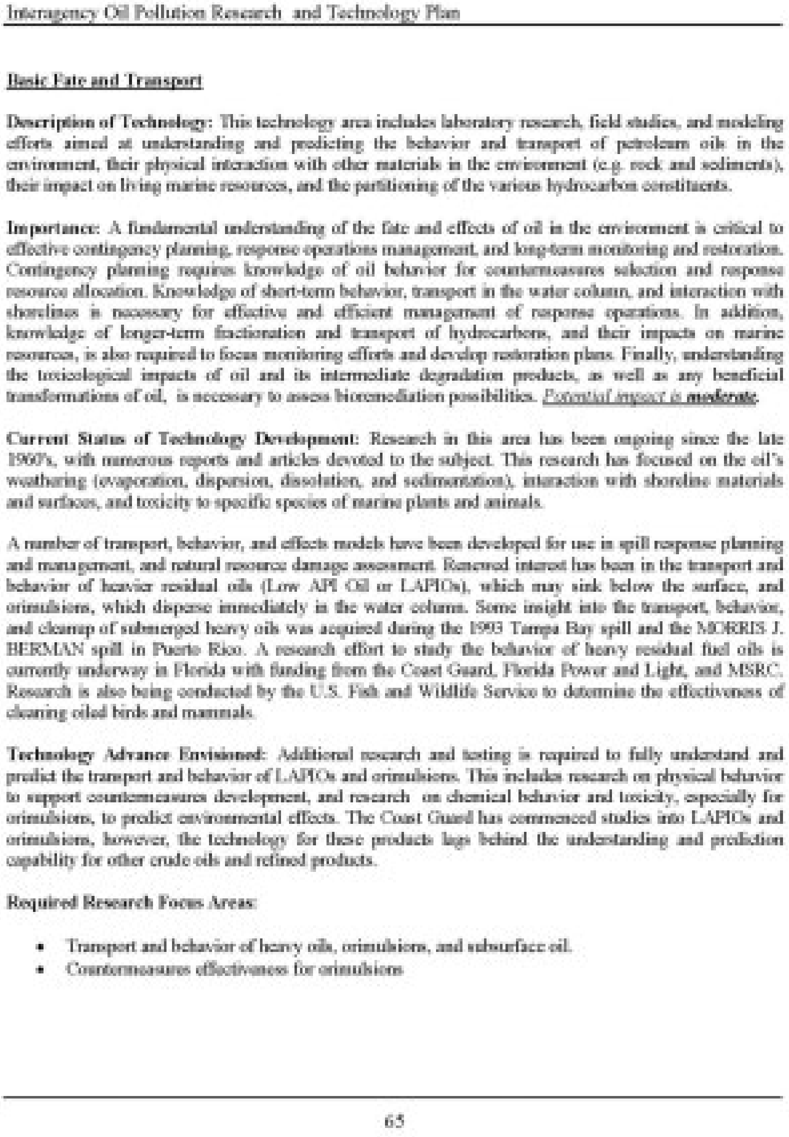
Technology Advance Envisioned: A comprehensive long-term research program is required to properly document and quantify oil spill impact and ecosystem recovery. This includes the development of procedures for establishing "set aside" areas to provide baseline data on recovery without cleanup and countermeasures, the establishment of long-term monitoring protocols and documentation procedures, and the establishment of a national network for compiling and preserving this information. Field monitoring efforts following major spills should be supplemented by laboratory-scale and mesoscale testing (including small experimental spills in the field), to sort out the impacts of the oil alone, from the impact of cleanup operations. Field monitoring procedures and protocols should be established as soon as possible, as valuable data are lost each time a major spill occurs and monitoring efforts are inadequate.

Required Research Focus Areas:

- Establish monitoring protocols and procedures
- Conduct laboratory and mesoscale studies of impact and recovery
- Establish integrated database of spill impact and recovery

References:

- Mearns, A., 1995.
- Sell, D., et al., 1995.



Basic Fate and Transport

Description of Technology: This technology area includes laboratory research, field studies, and modeling efforts aimed at understanding and predicting the behavior and transport of petroleum oils in the environment, their physical interaction with other materials in the environment (e.g. rock and sediments), their impact on living marine resources, and the partitioning of the various hydrocarbon constituents.

Importance: A fundamental understanding of the fate and effects of oil in the environment is critical to effective contingency planning, response operations management, and long-term monitoring and restoration. Contingency planning requires knowledge of oil behavior for countermeasures selection and response resource allocation. Knowledge of short-term behavior, transport in the water column, and interaction with shorelines is necessary for effective and efficient management of response operations. In addition, knowledge of longer-term fractionation and transport of hydrocarbons, and their impacts on marine resources, is also required to focus monitoring efforts and develop restoration plans. Finally, understanding the toxicological impacts of oil and its intermediate degradation products, as well as any beneficial transformations of oil, is necessary to assess bioremediation possibilities. *Potential impact is* ***moderate***.

Current Status of Technology Development: Research in this area has been ongoing since the late 1960's, with numerous reports and articles devoted to the subject. This research has focused on the oil's weathering (evaporation, dispersion, dissolution, and sedimentation), interaction with shoreline materials and surfaces, and toxicity to specific species of marine plants and animals.

A number of transport, behavior, and effects models have been developed for use in spill response planning and management, and natural resource damage assessment. Renewed interest has been in the transport and behavior of heavier residual oils (Low API Oil or LAPIOs), which may sink below the surface, and orimulsions, which disperse immediately in the water column. Some insight into the transport, behavior, and cleanup of submerged heavy oils was acquired during the 1993 Tampa Bay spill and the MORRIS J. BERMAN spill in Puerto Rico. A research effort to study the behavior of heavy residual fuel oils is currently underway in Florida with funding from the Coast Guard, Florida Power and Light, and MSRC. Research is also being conducted by the U.S. Fish and Wildlife Service to determine the effectiveness of cleaning oiled birds and mammals.

Technology Advance Envisioned: Additional research and testing is required to fully understand and predict the transport and behavior of LAPIOs and orimulsions. This includes research on physical behavior to support countermeasures development, and research on chemical behavior and toxicity, especially for orimulsions, to predict environmental effects. The Coast Guard has commenced studies into LAPIOs and orimulsions, however, the technology for these products lags behind the understanding and prediction capability for other crude oils and refined products.

Required Research Focus Areas:

- Transport and behavior of heavy oils, orimulsions, and subsurface oil.
- Countermeasures effectiveness for orimulsions

Appendix B. Oil Spill Data Base Comparison

IRIS	The Incident Reporting Information System is a relational database operated by the National Response Center (NRC) at the U.S. Coast Guard Headquarters. While it is used primarily for emergency response notification, IRIS supports the information needs of various National Response Team (NRT) agencies. The NRC collects information from reports (usually by telephone) on releases of oil and other hazardous substances from fixed facilities or during transit. The NRC relays the information immediately to the Federal On-Scene Coordinator who coordinates any potential federal response to the incident. The data are also entered directly into the database. Because of its use in immediate reaction, every report is entered as a record and none of the records are ever destroyed. Since records are initial notifications made during or immediately after a release occurs, exact details of the release are often incomplete, preliminary, or inaccurate. Updates to the notifications are occasionally provided. These, however, may be entered as a separate, duplicate record (leaving the initial record uncorrected if it is an update). IRIS forms the core of several of the other databases that collect more detailed or follow-up information to support release prevention, enforcement, and policy decisions. In addition to emergency notification, IRIS is useful for learning about a specific incident and performing statistical analyses on large data sets. When used for analyses, its inherent limitations must be considered.
ERNS	The Emergency Response Notification System (ERNS) is an EPA database that contains release notifications made to the NRC, as well as reports made to EPA regional offices. The EPA reports may be updates of or in addition to the NRC notifications. ERNS includes data from all transportation modes and facility types and uses an expansive definition of reportable oil release. Its uses and limitations are similar to those of IRIS.
HMIRS	The Hazardous Materials Incident Reporting System (HMIRS) is managed by DOT/RSPA. All releasing carriers must submit a written report whenever there is an unintentional release of a hazardous material during transportation. These reports make up the heart of HMIRS and are supplemented by the notifications that are in the IRIS database. Because the HMIRS database is based on written reports submitted by the carrier, details of each release are usually accurate. The majority of the information is validated, as fatality and injury information are verified through follow-up reports.
HLPAD	The Hazardous Liquid Pipeline Accident Database (HLPAD) is another DOT/RSPA database. Like HMIRS, it expands on IRIS with survey data for a targeted area. The database contains information on any failure in a pipeline system where the release meets certain threshold criteria. Telephone notifications to NRC that meet these criteria are entered in this database as well as IRIS. Pipeline operators must also submit written reports on these releases. This information is verified and entered into the database.
MSIS	The Marine Safety Information System (MSIS) is maintained by USCG. This database is based on investigations, rather than notifications or surveys. The Coast Guard collects information on about 10,000 fixed facilities and transportation accidents each year, including releases of petroleum and other substances. MSIS gathers a wide array of data to support the Coast Guard's overall mission. Therefore, the information goes well beyond pollution incidents. This additional information can add to analyses (for example, for a vessel that is involved in an incident, the database contains past releases and violations of that vessel). The Coast Guard

uses the information to prioritize activities to maximize use of Coast Guard resources for prevention, response, investigations, facility inspections, and vessel boardings and inspections.

WTSD The Worldwide Tanker Spill Database (WTSD) is run by MMS. MMS uses the database to evaluate fully the risk of oil spills from the Outer Continental Shelf Gas and Oil Program, other domestic oil movements, and the tankering of imported oil. MMS updates and maintains a comprehensive database of accidental tanker and barge oil spills in coastal and offshore waters worldwide, greater than or equal to 1,000 barrels. It compiles the information from a variety of public and private databases and listing services, including MSIS.

OPAC The Offshore Pollution and Accident Compilation (OPAC) system is maintained by MMS. The database is used to track accidents including pollution incidents that have occurred as a result of OCS oil and gas activities which were investigated by the MMS. Historically, very little OCS oil has been transported by tanker, most of the transportation spills in the OPAC are from offshore pipelines. Nearshore platforms have been served by barge but few reports on barge spill are included in the database. The database is not user-friendly and queries of specific types of incidents are difficult to execute. Information is based on reports from responsible parties, and MMS District and Regional Offices with a minimum level of validation. The database is updated periodically.

Table B- 1. Database Comparison - Scope

Federal Databases							
Field	**IRIS**	**ERNS**	**HMIRS**	**HLPAD**	**MSIS**	**WTSD**	**OPAC**
Chemicals Covered	Petroleum and other substances	Petroleum and other substances	Petroleum and other substances	Petroleum and other substances	Petroleum based products and other oil products, chemicals, garbage and natural substances	Petroleum	Petroleum and other substances
Transporta-tion modes and fixed facilities covered	All modes, all fixed facilities	All modes, all fixed facilities	All modes, all fixed facilities	Pipeline only, no fixed facilities	All modes, all fixed facilities	Marine barges and tankers only, no fixed facilities	Offshore oil and gas platforms, pipelines, work boats, barges, tankers
Geographic coverage	US and its territories	US and its territories	US and its territories	US and its territories	US navigable waters	Worldwide	U.S. Outer Continental Shelf, Gulf of Mexico and Southern California
Criteria that trigger inclusion in database (for an oil spill)	Oil release that violates applicable water quality standards, causes a film, or causes a sludge/ emulsion beneath the surface of the water	Oil release that violates applicable water quality standards, causes a film, or causes a sludge/ emulsion beneath the surface of the water	Any unintentional release of oil during the course of transportation	(1) Explosion or fire; (2) loss of 50 or more barrels of liquid; (3) release of more than 5 barrels per day of liquefied gas; (4) death; (5) property damage of at least $50,000	A release that violates applicable water quality standards, and in the case of an oil spill causes a film, or sludge/ emulsion beneath the surface of the water	An accidental tanker or barge spill inland, coastal or offshore waters world wide that is at least 1,000 barrels of the vessel's cargo or own fuel	Spill greater than one barrel investi-gated by DOI/ MMS (Explosion, fire, death, large property loss always investigated)

Table B-1. Database Comparison - Scope (cont.)

Federal Databases							
Field	**IRIS**	**ERNS**	**HMIRS**	**HLPAD**	**MSIS**	**WTSD**	**OPAC**
Information gathering: (1) Who provides	By person associated with the facility or transportation vehicle that had the release, or government official, or private citizen	By person associated with the facility or transportation vehicle that had the release, or government official, or private citizen	Representative of the releasing carrier	Pipeline operators	A person associated with the vessel or facility, anyone witnessing the incident, a private citizen, or USCG investigator	Data collected from secondary sources.	Initial report by operator (responsible party)
(2) How provided or obtained	NRC Incident notification system (telephone reports during or immediately after release)	IRIS, plus reports by EPA regions	IRIS, plus written report to DOT	IRIS, plus written report to DOT	USCG Investigations	MMS collection of information from a variety of other databases and secondary reporting services	Written report to DOI/MMS from operator, plus any follow-up investigations by operator/ USCG/MMS
Limitations of the data	May not be complete, accurate, or finalized since based on immediate reports by an observer. May be duplicates or multiple notifications about a single release since all reports are recorded	May not be complete, accurate, or finalized since based on immediate reports by an observer. May be duplicates or multiple notifications about a single release since all reports are recorded			The size, richness, and complexity of the database make data extractions and analyses laborious	International reporting of barge and inland spills is limited.	May not be complete. The richness, and complexity of the database make data extraction and analyses laborious
Availability of database updates	Continuously	Continuously	Quarterly	Every 2 - 4 weeks	Every 3 months	Continuously	Quarterly to annually

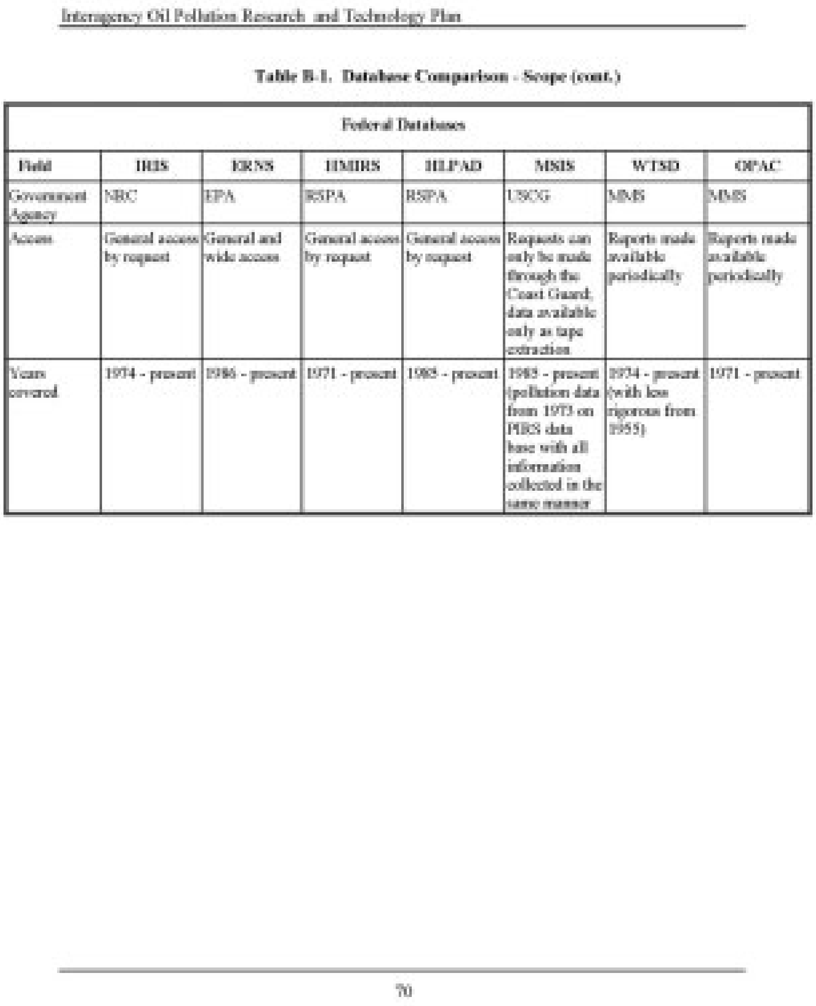


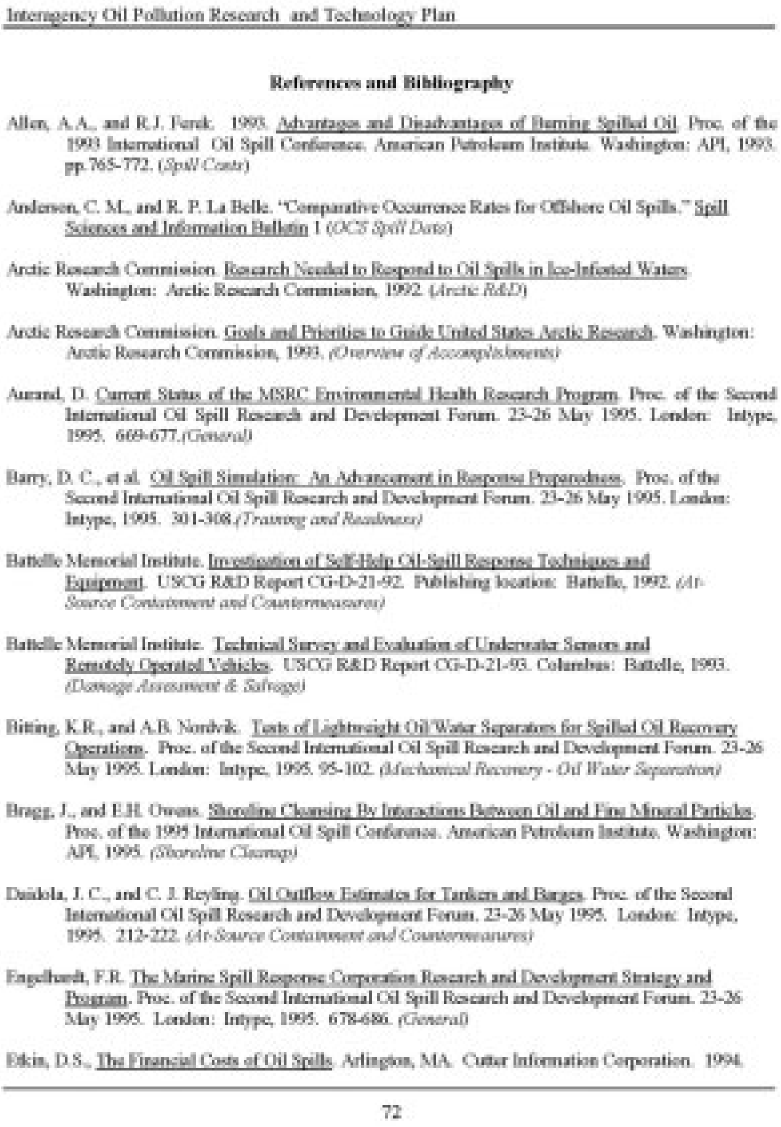
Table B-1. Database Comparison - Scope (cont.)

Federal Databases							
Field	**IRIS**	**ERNS**	**HMIRS**	**HLPAD**	**MSIS**	**WTSD**	**OPAC**
Government Agency	NRC	EPA	RSPA	RSPA	USCG	MMS	MMS
Access	General access by request	General and wide access	General access by request	General access by request	Requests can only be made through the Coast Guard; data available only as tape extraction	Reports made available periodically	Reports made available periodically
Years covered	1974 - present	1986 - present	1971 - present	1985 - present	1985 - present (pollution data from 1973 on PIRS data base with all information collected in the same manner	1974 - present (with less rigorous from 1955)	1971 - present

Table B- 2. Database Comparison - Data Elements

Data Category	Data Elements	Federal Databases						
		IRIS	ERNS	HMIRS	HLPAD	MSIS	WTSD	OPAC
Event reporting information	Reporting party	*	*	*	*	*	*	
	Date and time reported	*	*	*	*	*	n/a	
Facility / release location	Facility name and address	*	*	*	*	*	*	*
	Release location	*	*	*	*	*	*	*
Release data	Date	*	*	*	*	*	*	*
	Transportation mode	*	*	*	*	*	*	*
	Type of vehicle			*	*	*	*	
	Vessel/vehicle number	*	*		*	*		
	Vehicle/container information			*	*		i	
	Shipment information			d			e	
	Quantity	*	*	*	*	*	*	*
	Quantity in water	*	*			*		
	Type of medium effected	c	d			*	g	
	Name of waterway effected	b	b			*	b	
	Type of release (spill, fire,etc.)	b		*	*	*		*
Release cause	Primary cause	a, b	a, b	a	a	c	c	*
	Contributing factors			*		*	h	*
Damages	Deaths	*	*	*	*	*	*	*
	Injuries	*	*	*	*	*		*
	Amount of property damages	*	*	*	*	*		
	Extent of environmental damage	b		b			b	
Additional Comments	Additional Comments	*	*	*		*		*

Notes: a) Laundry List
b) Description Field Available
c) Chain of Events
d) Origin/Destination
e) Level of Load
f) Distance From Coast
g) Air, Groundwater, Land, Water
h) Severe Weather Only
i) vessel size
n/a) not applicable



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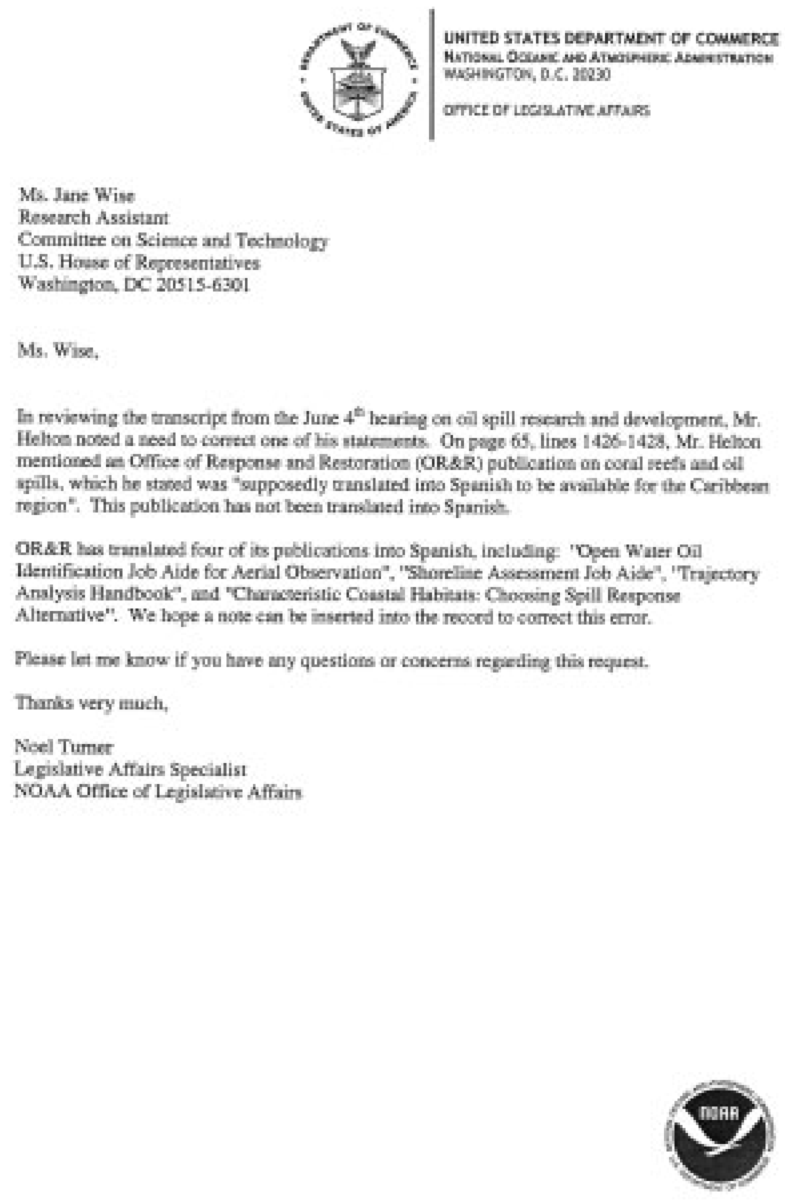

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
WASHINGTON, D.C. 20230

OFFICE OF LEGISLATIVE AFFAIRS

Ms. Jane Wise
Research Assistant
Committee on Science and Technology
U.S. House of Representatives
Washington, DC 20515-6301

Ms. Wise,

In reviewing the transcript from the June 4th hearing on oil spill research and development, Mr. Helton noted a need to correct one of his statements. On page 65, lines 1426-1428, Mr. Helton mentioned an Office of Response and Restoration (OR&R) publication on coral reefs and oil spills, which he stated was "supposedly translated into Spanish to be available for the Caribbean region". This publication has not been translated into Spanish.

OR&R has translated four of its publications into Spanish, including: "Open Water Oil Identification Job Aide for Aerial Observation", "Shoreline Assessment Job Aide", "Trajectory Analysis Handbook", and "Characteristic Coastal Habitats: Choosing Spill Response Alternative". We hope a note can be inserted into the record to correct this error.

Please let me know if you have any questions or concerns regarding this request.

Thanks very much,

Noel Turner
Legislative Affairs Specialist
NOAA Office of Legislative Affairs

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